Proceedings of the 1998 Prairie Fish Habitat Management Workshop

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2000

PROCEEDINGS OF THE 1998 PRAIRIE FISH HABITAT MANAGEMENT WORKSHOP

by

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ABSTRACT

Chang-Kue, K.T.J. (editor). 2000. Proceedings of the 1998 Prairie Fish Habitat Management Workshop. Can. MS. Rep. Fish. Aquat. Sci. 2522: ix + 155 p.

A Prairie Fish Habitat Management Workshop was held at Hecla Island, Manitoba on June 3-5, 1998. The workshop was sponsored by the Department of Fisheries and Oceans, Habitat Management Division (DFO-HM) with input and cooperation from the provinces of Alberta, Saskatchewan, Manitoba and Ontario. The workshop objectives were:

- To share information and experiences related to provincial and DFO habitat management and science programs,
- To identify areas in which common approaches to problems and exchange of information could be usefully shared to avoid duplication and overlap of effort,
- To identify common challenges that affect inland provinces, and to identify priority challenges that require a collaborative response by habitat management practitioners in the four central Canadian provinces,
- To identify actions and roles necessary to address the challenges,
- To create a foundation for future action, including an ongoing steering process.

Separate breakout sessions dealing with 15 pre-selected topics were held involving 70 workshop participants. The workshop topics centered on key issues and activities with the potential to impact fishes and fish habitats in the four provinces. Participants (12-15 persons) in each breakout session produced recommendations addressing their assigned topic from a joint federal and provincial perspective. Recommendations were separated into three categories:

1. **Common Objectives** – for achieving effective management of fish habitat;
2. **Gaps/Barriers/Opportunities** – that pose impediments to or facilitate achieving the common objectives;
3. **Actions** – to be undertaken to address the identified gaps/barriers /opportunities.

All the recommendations per category for the 15 sessions are reported in detail in Section 3 of this report.

Recommendations arising from each breakout session were presented during a plenary session to all participants who then voted to indicate their level of support [Agree; Partial Disagreement; Disagree] for each of the three categories. Table 1 summarizes the support recorded for all the recommendation categories for the 15 workshop topics; topics are also listed in order of overall perceived support. The table also shows that the support registered by plenary participants for several categories differed from the presumed high degree of consensus attained by the smaller breakout groups. A recommendation category that attained low support indicates that there are issues within a topic that warrant further attention. Senior federal and provincial habitat managers should take these into consideration as they progress towards administering regional fish habitat management programs in a collaborative and consistent manner.

Table 1. List of workshop topics and the level of support registered by workshop participants for each topic's three recommendation categories.

WORKSHOP TOPIC	RECOMMENDATION CATEGORIES AND LEVEL OF SUPPORT (Percent Agree)			AVERAGE (Percent Agree)
	OBJECTIVES	GAPS/BARRIERS/ OPPORTUNITIES	ACTIONS	
1. Wild Rice	78	87	87	84.0
2. Applying No Net Loss Quantitatively	90	80	80	83.3
3. Channelization	69	88	88	81.7
4. Agricultural Trends and Impacts	81	72	75	76.0
5. Road Crossings	69	84	74	75.7
6. Cumulative Effects	72	77	67	72.0
7. Instream Flow Needs	63	70	70	67.7
8. Biodiversity	75	70	58	67.7
9. Whole Lake Destruction	68	63	71	67.3
10. Pipeline Crossings	69	59	57	61.7
11. Hydro Peaking	61	58	56	58.3
12. Gravel Removal	60	58	47	55.0
13. Timber Harvesting Impacts	55	45	48	49.3
14. Regional Scale Projects	-	82	-	*
15. Habitat Transfer	-	72	-	*

- No list produced
* Insufficient data

Key Words: Fish habitat; habitat management; habitat issues; program development; prairie provinces; Ontario; workshops.

RÉSUMÉ

Chang-Kue, K.T.J. (editor). 2000. Proceedings of the 1998 Prairie Fish Habitat Management Workshop. Can. MS. Rep. Fish. Aquat. Sci. 2522: ix + 155 p.

Un atelier sur la gestion de l'habitat des poissons des Prairies a eu lieu à Hecla Island (Manitoba) du 3 au 5 juin 1998. L'atelier était parrainé par le ministère des Pêches et des Océans, division de la gestion de l'habitat (MPO-GH), en collaboration avec les provinces de l'Alberta, de la Saskatchewan, du Manitoba et de l'Ontario. Les objectifs de l'atelier étaient les suivants :

- Partager de l'information et des expériences relativement aux programmes scientifiques et aux programmes de gestion de l'habitat du MPO et des provinces;
- Cerner des secteurs où il serait utile de travailler conjointement pour régler des problèmes et d'échanger des renseignements afin d'éviter les chevauchements;
- Repérer les problèmes communs aux provinces de l'intérieur et déterminer quels sont les problèmes prioritaires exigeant une réponse conjointe des intervenants en gestion de l'habitat des quatre provinces centrales du Canada;
- Cerner des mesures et des rôles nécessaires pour régler les problèmes;
- Créer des assises pour les mesures à prendre dans l'avenir, notamment un processus de direction permanent.

On a organisé des réunions en petits groupes portant sur 15 sujets choisis au préalable (tableau 1) et regroupant 70 participants. Les thèmes de l'atelier avaient principalement trait aux principales questions et activités susceptibles d'avoir des répercussions sur les poissons et les habitats du poisson dans les quatre provinces. Les participants (de 12 à 15 personnes) de chaque sous-groupe ont formulé des recommandations relatives au sujet leur ayant été assigné d'un point de vue fédéral et provincial. Les recommandations ont été divisées selon les trois catégories suivantes :

4. **Objectifs communs** – en vue de la gestion efficace de l'habitat du poisson;
5. **Lacunes/obstacles/possibilités** – facteurs entravant ou favorisant l'atteinte des objectifs communs;
3. **Mesures** – gestes à poser pour donner suite aux lacunes/obstacles/possibilités.

Toutes les recommandations (par catégorie) des 15 groupes sont décrites en détail dans la Section 3 du présent rapport.

Les recommandations issues de chacune des réunions en petits groupes ont été présentées à l'ensemble des participants au cours d'une assemblée plénière. Les participants ont alors fait connaître, au moyen d'un vote, leur niveau de soutien [d'accord, d'accord en partie seulement, en désaccord] pour chacune des trois catégories. Le tableau 1 résume le degré de soutien (pourcentage de personnes se disant d'accord) de chacune des catégories de recommandations des 15 sujets abordés au cours de l'atelier. Les sujets y sont également indiqués dans l'ordre du niveau de soutien obtenu. Le tableau permet en outre de constater que, pour plusieurs catégories, le niveau de soutien accordé en plénière diffère du supposé large consensus recueilli au cours des

réunions en petits groupes. Un faible niveau de soutien pour une catégorie de recommandation donnée indique que certaines questions relevant d'un sujet méritent une plus grande attention. Les gestionnaires supérieurs fédéraux et provinciaux dont les fonctions ont trait aux habitats devraient tenir compte de ces résultats au fur et à mesure qu'ils progresseront sur la voie de l'administration cohérente et conjointe des programmes régionaux de gestion de l'habitat du poisson.

Tableau 1. Liste des sujets de l'atelier et niveau de soutien accordé par les participants de l'atelier pour les trois catégories de recommandation de chaque sujet.

SUJET D'ATELIER	CATÉGORIES DE RECOMMENDATION ET NIVEAU DE SOUTIEN (pourcentage de participants d'accord)			MOYENNE (% d'accord)
	OBJECTIFS	LACUNES/ OBSTACLES/ POSSIBILITÉS	MESURES	
1. Riz sauvage	78	87	87	84,0
2. Ne pas appliquer de perte nette quantitativement	90	80	80	83,3
3. Canalisation	69	88	88	81,7
4. Tendances et impacts agricoles	81	72	75	76,0
5. Traversées routières	69	84	74	75,7
6. Effets cumulatifs	72	77	67	72,0
7. Besoins - débit d'entrée	63	70	70	67,7
8. Biodiversité	75	70	58	67,7
9. Destruction de tout un lac	68	63	71	67,3
10. Traversées de pipeline	69	59	57	61,7
11. Hydroélectricité - période de pointe	61	58	56	58,3
12. Enlèvement de gravier	60	58	47	55,0
13. Répercussions de la récolte du bois	55	45	48	49,3
14. Projets à l'échelle régionale	-	82	-	*
15. Transfert d'habitat	-	72	-	*

\- Aucune liste produite
* Données insuffisantes

Mots clés : habitat du poisson; gestion de l'habitat; questions relatives à l'habitat, élaboration de programmes, provinces des Prairies; Ontario; ateliers.

1.0 INTRODUCTION AND WORKSHOP PROCEDURE

The Prairie Fish Habitat Management Workshop was sponsored by the federal Department of Fisheries and Oceans (DFO) – Habitat Management Division, Central and Arctic Region, in co-operation with the provinces of Alberta, Saskatchewan, Manitoba and Ontario. It was held on June 3-5, 1998 at the Gull Harbour Resort on Hecla Island, Manitoba. The event brought together federal and provincial agency representatives with the expertise and day-to-day working experience in the management and protection of fish and fish habitat in the four provinces. The planning and logistics of this workshop were assigned to a Habitat Management Working Group (Organizing Committee) in late 1997 (see **Appendix A**). The 70 invited participants (see **Appendix B**) also included non-government specialists and habitat management staff from other DFO regions.

The objectives of the workshop were:

- To share information and experiences related to provincial and DFO habitat management and science programs,
- To identify areas in which common approaches to problems and exchange of information could be usefully shared to avoid duplication and overlap of effort,
- To identify common challenges that affect inland provinces, and to identify priority challenges that require a collaborative response by habitat management practitioners in the four central Canadian provinces,
- To identify actions and roles necessary to address the challenges,
- To create a foundation for future action, including an ongoing steering process.

From a regional perspective, it has become increasingly apparent that there are impediments to our goal of protecting fish and fish habitat in a consistent manner because of federal and provincial operational policies and dissimilar priorities among the four provinces. Inter-jurisdictional issues within each province may also contribute to the problem. A regional habitat workshop to address current and forthcoming habitat and assessment issues was proposed by senior federal and provincial habitat managers. After the Organizing Committee identified a set of 16 major topics for the workshop, Mr. Bill McMillan of Equus Consulting Group, Edmonton, was retained to manage and facilitate the workshop.

DFO and provincial managers were asked to prepare background reports providing an overview of habitat management issues in their respective jurisdictions. In addition, an overview of DFO Science was prepared by Dr. Ken Minns. These reports were presented by their respective authors to all workshop participants on day 1 of the workshop (3 June 1998) and the full text of these overviews are provided in **Section 2** of this report.

Mr. McMillan utilized various background notes/materials to prepare a short Background Report on each of the 16 workshop topics. A key list of "straw man" objectives was created for each topic. These objectives were to be used as a starting point for discussion in the respective workshop breakout session.

Five individuals were invited to present a technical paper that highlight current scientific and technical expertise in habitat management issues. These presentations were interspersed among the series of workshop breakout and plenary sessions.

Each workshop participant was sent, in mid-May 1998, a Workshop Binder that contained, among others, the following information:

A. Workshop Objectives and Agenda (see **Appendix C**).
B. Guiding Principles for Fish Habitat Management (see **Appendix D**): a suggested list of guiding or "straw man" principles open to deletion, modification or addition.
C. Breakout Session Guidelines and Menu of Habitat Management Tools (see **Appendix E**).
D. A short Background Report and "straw man" objectives for each of the sixteen Workshop Topics scheduled for the Breakout Sessions:

    1. Applying No Net Loss Quantitatively.
    2. Whole Lake Destruction.
    3. Cumulative Effects.
    4. Regional Scale Projects.
    5. Timber Harvesting Impacts on Watersheds
    6. Buffers.
    7. Instream Flow Needs.
    8. Hydro Peaking.
    9. Agricultural Trends and Anticipated Impacts
    10. Channelization and Drainage.
    11. Road Crossings.
    12. Pipeline Crossings.
    13. Gravel Removal.
    14. Wild Rice.
    15. Biodiversity.
    16. Habitat Transfer.

E. Provincial and DFO Habitat Management Overview reports (see **Section 2**).
F. Extended abstracts for five technical presentations (see **Appendix F**).
G. A list (May 1998) of available habitat management guidelines and pertinent, selected publications.

On June 4, 1998, and again on June 5, 1998, four breakout discussion groups, each consisting of 15-18 participants pre-selected by the Working Group, were assigned to discuss **two** topics over a three hour time span. Each topic was assigned a facilitator and a recorder. The group was asked to create three lists of **recommendations** that were **categorized** as follows:

1. Common **Objectives** to achieve effective regional habitat management from a joint federal and provincial perspective.
2. The five most important **Gaps, Barriers and/or Opportunities** that will forestall or facilitate our ability to address the list of objectives.

3. The five most important **Actions** required to address the preceding list of gaps/barriers/opportunities.

Each of the above list of recommendations was to be drafted after group members collectively voted on a larger list of ideas, observations and comments derived from the brain-storming exercise and discussions over a scheduled 90 minute **breakout** session. Each group reported their results to all workshop participants in a **plenary** session later in the day. After each plenary presentation, workshop participants used an electronic vote tallying system, provided by Equus Consulting, to indicate their level of support and agreement for these recommendations (i.e., Agree; Partially Disagree; Disagree). Fifty-three electronic keypads (Optionfinder system) were provided; each keypad could only be used by one participant to provide one response.

As expected, the depth of discussion for each topic varied among such a gathering of individuals drawn from provincial and federal staff. Most breakout groups focused their time equally on their two assigned topics while some found insufficient time to direct as much attention to their second topic. Of the 16 topics scheduled, "Buffers" was not covered specifically because it was incorporated into the "Timber Harvest Impact" session. Results of the sessions on the final 15 workshop topics are reported in **Section 3.** An overall summary of the plenary session recommendations and an analysis of the level of support by all workshop participants for these recommendations are provided in **Section 4.** Proposed actions to address workshop recommendations are discussed in **Section 5**.

In the closing hour of the workshop, each participant was given a questionaire that included a list of "Guiding Principles for Fish Habitat Management" that had been provided for reference (see Appendix D) at the start of the workshop. Each participant was asked to vote, on a scale from 1 to 5 (1=strongly disagree; 3=neutral; 5=strongly agree), for each principle to determine their relative importance in one's decision making process. This ranking of the key guiding principles used by participants in their habitat management activities is summarized in **Section 6**.

Participant evaluations and specific comments on the Prairie Habitat Management Workshop are also presented in **Section 6**.

2.0 PROVINCIAL AND FEDERAL HABITAT MANAGEMENT OVERVIEWS

2.1 ALBERTA

Alberta Habitat Management Overview

Prepared by:
Ken Crutchfield
Head, Trust Fund, Habitat and Forestry
Alberta Environmental Protection.

General Introduction

The General Setting:

- Alberta has a wide variety of aquatic habitats, i.e., alpine to shield to shortgrass prairie.
- 60 fish species, of which 51 are native and 9 have been introduced.
- 18 fish species are important in recreational, commercial or domestic fisheries.
- 42 species are indices of biodiversity.
- 2.5 percent of Alberta's surface area is freshwater.
- Surveys conducted on over 2100 lakes with only about 1030 having game fish producing capabilities. (Saskatchewan - estimated 94 000, Manitoba has 110 000 and Ontario has 250 000 fish-bearing lakes).
- Alberta has 250 anglers per lake (Saskatchewan, Manitoba and Ontario - two anglers per lake).
- Approximately 3/4 of the lake area in Alberta is located north of a line through Lac La Biche and Valleyview (northern half of the province).
- Approximately 3/4 of Alberta population lives in the area south of the line through Lac La Biche and Valleyview.
- Fish populations in Alberta have declined as a result of over-harvest and habitat alteration
- Alberta accepts healthy, uncontaminated fish as indicators of a healthy aquatic environment.

The Management-Regulatory Setting

Alberta Environmental Protection (AEP) is the fish and fish habitat advocate within the Alberta government. Situated within the Natural Resources Service is the newly consolidated Fisheries and Wildlife Management Division. The consolidation became effective April 14, 1998. Ken Ambrock is the new Director. This consolidated Division is one of five within Natural Resources Service.

Figure. 1. Proposed operational and management area boundaries – Alberta Natural Resources Service.

The recent consolidation reflects a move within AEP towards a departmental structure that emphasizes headquarters' responsibility for program and policy decisions and the regions for delivery. The basic unit for program delivery is the Management Area. The result is seventeen areas spread amongst six regions (Figure 1). Fisheries management program responsibilities will be split amongst the 17 areas with all but 3 of the areas having at least one fisheries person situated within an area office. Additional changes are likely to occur as the Department and Service move away from programs that operated on a sectoral basis (decisions, authority and resources flowed separately through chains of command for individual programs) towards an integrated approach to service delivery.

In an earlier change, April 1997, the government delegated the administration of the Fish and Wildlife Trust Fund to the not-for-profit Alberta Conservation Association (ACA). The Fish and Wildlife Trust Fund included the Fisheries Habitat (***Buck for Wildlife***), Management - Enhancement, and Enhanced Provincial Fish Stocking programs. These proactive programs were funded through a levy attached to the sale of sport fishing licences. The item perhaps of most significance to this workshop was the delegation of Fisheries Habitat Development program to the ACA. In the 25 years preceding delegation substantial investments had been made in fish habitat related initiatives. Program activities ranged from the protection of important fish habitat, e.g., stream bank-riparian fencing, Cows & Fish, to enhancement, e.g., lake aeration, and development, e.g., new pond creation. Levies received with the sale of fishing licences supported annual investments of approximately $2.5M on the three fisheries programs ($1.2M towards fisheries habitat development). A significant complement of trained long term and seasonal staff went with the delegation. In its current role, the Fisheries and Wildlife Management Division now "advises" the ACA on appropriate investments.

Administration of the Fish Habitat Provisions of the Fisheries Act

Alberta accepts and uses the federal Fish Habitat Policy (No Net Loss) as a ***working guideline*** for decision making. (Letter - P. Melnychuk, Deputy Minister-AEP to W. Rowat, Deputy Minister-DFO December 19, 1996).

Alberta Environmental Protection staff has been directed to focus their attention on provincial regulatory processes to protect fish and fish habitat, and public navigation. AEP will no longer actively participate in **federal** regulatory processes involving fish habitat and navigable waters protection as they pertain to the ***Fisheries Act*** and the ***Navigable Waters Protection Act***. AEP staff, specifically fisheries and water management staff, are directed to focus their efforts to provincial regulatory review processes. Further, they are to defer from any active involvement, (e.g., provision of resource information, sharing of input to provincial regulatory processes) in federal regulatory processes concerning the fish habitat provisions of the *Fisheries Act* and/or *Navigable Waters Protection Act*. Federal authorities will be directed to present themselves in person to gather information for their regulatory processes. Copies of provincial permits will be provided upon written request.

AEP staff will continue to be involved in the review of projects and offer advice to Provincial regulators on the appropriate measures to safeguard Alberta's interest in its fish-fish habitat and navigable waters. Instead of using the federal legislation to safeguard its interests, Alberta will use existing provincial regulatory processes to address the need; much like Alberta had prior to the federal authorities becoming more active in this area in the mid-1980's. AEP staff involvement will include:

- Review plans, permits and proposals, as per referral guidelines, to determine if the proposed works are likely to affect fish-fish habitat, and navigation as they relate to areas of Provincial jurisdiction;

- Work with proponents and consultants to design fish mitigation measures to minimize effects on fish-fish habitat and navigation as they relate to areas of Provincial jurisdiction;

- Enforcement of the *Fisheries Act*.

AEP currently has 41 permanent staff assigned to Fisheries Management programs, exclusive of fish culture operations. Two of 9 headquarter staff are responsible for overseeing provincial fish habitat program and policy. Further changes are anticipated with the amalgamation of Fisheries and Wildlife Management Divisions. Specific fish habitat responsibilities will vary amongst field staff, but generally speaking fish habitat responsibilities are common to all fisheries field staff.

Emerging Issues for Fish Habitat Management

Staffing: An ageing workforce, limited to non-existent recruitment over the last 10 – 15 years and government downsizing has resulted in a skewed workforce, i.e., wide spread in age and experience amongst the largest work cohorts. There is the likely prospect of considerable expertise and knowledge "walking out the door" with anticipated retirements.

Biology- Ecology of Alberta Fish Species: Aside from fish stocks managed for sport and commercial fishing, little is known of the other fish species. With increasing emphasis on aquatic communities, there is increasing pressure to incorporate the interests of other fish species into land and water management operational activities.

Intensification of Land Use: Alberta landscapes, not unlike other provinces and territories, has been undergoing a transformation due to pressures of settlement and development, but there are some recent events that have significantly escalated the rate and extent of change. These developments are likely to have a significant impact into the future. They include:

Oil & Gas:

Conventional Reserves (province wide)– marginal reserves are becoming economical, increased pressure to identify "missed" conventional hydrocarbon sources through 3D seismic, improved technology, e.g., directional drilling to

access previously inaccessible resources (under water bodies), "underwater extraction platforms";

Non-Conventional Reserves (Cold Lake, Ft. McMurray and Peace River areas)- accelerated oil sands development (surface mining, in-situ) which upset entire watersheds, use of "tailings ponds", increased demand for surface water to augment or drive secondary field recovery;

Processing/Distribution – expansion of pipeline network to tie into previously unserviced areas, potential duplicative pipeline networks in response to a more open distribution market;

Abandonment of Facilities – includes pipelines, well-sites, sumps. These present unique challenges given their long history of use, various ownership and the potential consequences arising with their abandonment "in-place".

Forestry:

There has been significant expansion of commitments in the late 1980's-early'90's; we've seen, for example, a change from two to seven pulp mills and a slow transition from clear cut logging to other sustainable forestry practices. This has resulted in significant landscape change over extensive areas of the northern boreal and foothill forests. There is increasing pressure to utilize buffers, i.e., extract merchantable wood. There is also pressure to improve fibre production through the use of herbicides and genetics.

Agriculture:

Recent commitment to increase hog and cattle production will place additional demand on private and public lands. This will likely result in additional land clearing, changes to water quality, and increased conflict over access to fish bearing waters.

Road Construction:

Coincident with increases in resource extraction is the increased demand for aggregate, a limited resource found to be most accessible within or adjacent to watercourses. There has been an increased demand to remove aggregate material from stream channels and flood plains.

Regulatory Practices:

The trend towards placing greater emphasis on the proponent to aquaint themselves with regulatory requirements and remove the regulator from pre-development stages changes risks. Concerns arise over potential problems associated with poorly defined or over-generalized regulatory standards as well as inadequate performance monitoring and inconsistent correction practices.

Water Act:

Alberta is bringing in a new Water Act which includes the use of instruments known as "Codes of Practice"(COP). All pipelines roads (exclusive of roads built on causeways crossing wetlands) and hydrostatic testing will be regulated under a

Code of Practice. In essence the COP allows proponents to proceed provided they comply with the conditions specified in the COP. In addition to the challenge this presents to fish habitat managers to predefine the circumstances under which these activities could be accepted, is the larger issue of managing the "cumulative effect" of multiple installations over a period of time.

Water Demand / Water Quality:

The inverse spatial relationship between settlement-production demands and the availability of a water supply will escalate historical water supply and quality pressures on aquatic environments within the South and North Saskatchewan river watersheds.

Future Habitat Management Challenges

As it pertains to Fish Habitat Programs:

- **Transcribing the Fish Conservation Strategy into an operational strategy** – Alberta has prepared a Fish Conservation Strategy that requires refinement to enable managers to describe what this means in a species, spatial and temporal context.
- **Understanding the cumulative effects** of various activities and the consequences this presents to the management of fish stocks and achievement of long-term fish management objectives. Complementary to this will be the need to improve our capability to assess the performance of various proponents operating independently of one and other to comply with fish habitat management expectations. Improved tools will need to be devised to enable fish managers to develop approaches for assessing and measuring cumulative effects, as well as monitoring habitat change.
- **Quantifying habitat change with fish production**. This capability will better enable fish habitat managers to understand change processes and what effects it can have on fish production. Included is the ability to discriminate changes arising from various activities affecting the same resource variables.
- **Changing regulatory practices** for Alberta fish habitat managers that have historically relied on other provincial regulatory processes to address fish habitat concerns; this will require increased emphasis on pre-identification of fish/fish habitat interests, criteria and standards.
- **Defining a fish habitat base** to sustain quality fish stocks that are diverse in age and species; to return depleted fish stocks to 85% carrying capacity.
- **Clearer and stronger policies**, procedures, practices developed for habitat and fish protection, e.g., development of mitigation and compensation protocols, development of enforcement protocols with other regulators, auditing protocols to judge whether land use conditions are effectively meeting fish habitat needs.
- **Better science** to support field programs, e.g., inventory protocol (lentic/lotic).
- **Improved knowledge** on the biology and ecology of all Alberta fish species.

- **Planning for succession**. Resource agencies have an intergenerational responsibility. A challenge is devising program strategies to enable a progressive transition of responsibility with staff succession.

As it pertains to resourcing fish habitat programs:

- **"Doing better with less":** Increased focus on empowering others to achieve fish /fish habitat management objectives.
- **Proponent provides baseline data:** Increased emphasis on the proponent to pre-plan their activities and make information available for assessment of performance.
- **Proactive information and education program** on habitat maintenance, e.g., partnership with industry.
- **Defining realistic projections** of staffing and resources needed to support desired level of habitat management.

As it pertains to Fish Habitat Staff

- Conflict resolution skills to deal with mediation of conflicting demands for the same resource base that also supports fish.
- **Definition of staff expertise** to support habitat program.
- Action plan for **staff training and upgrading.**

Closing Comment: The shortcoming of any overview is the liability of underdescribing whatever it is that is being addressed. This overview is no different, but it should give the reader some insight into the issues now being confronted by fish managers within Alberta and where they are likely to be deploying their energies and resources in the near future.

Errors and omissions are of my own making and I accept responsibility for same.

Ken Crutchfield
May 18, 1998

2.2 SASKATCHEWAN

Saskatchewan Habitat Management Overview

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Saskatchewan Environment and Resource Management (**SERM**) has been dealing with fish habitat management for the past twenty years through provincially administered legislation. Currently, the provincial *Environmental Management and Protection Act* provides the basis for most of the fish habitat management activities in Saskatchewan. Section 18.1 of this Act prohibits the alteration of the bed or bank of any water body, the removal of material from the bed or bank of a water body, the addition of material to the bed or bank of a water body, or the removal of aquatic vegetation from a water body. This section further provides for permits to be issued allowing the above activities, and for appropriate conditions to be included on such permits. In addition, the habitat provisions of the Fisheries Act are cooperatively administered and enforced by SERM.

Two sections of SERM are involved in fish habitat management: Fish and Wildlife Branch and Regional Operations. Fish and Wildlife Branch is mainly involved in policy oriented work while Regional Operations is responsible for delivery of habitat management programs at the field level.

Fish and Wildlife Branch activities include legislation and policy development, guideline development, technical support to the regions, advice on administrative and enforcement activities, and input to the environmental assessment process. In addition, Fish and Wildlife Branch, through the Fish and Wildlife Development Fund, leads fish enhancement initiatives, including improvement of fish habitat. Fish and Wildlife Branch also reviews projects with potential for harmful alterations to fish habitat and works cooperatively with DFO to negotiate and oversee implementation of fish habitat compensation agreements.

Regional Operations (Regional Fisheries Biologists and Conservation Officers) are responsible for field delivery of habitat programs. Regional staff administers the permitting provisions of the Environmental Management and Protection Act. This includes reviewing project proposals, determining if projects are acceptable, determining permit conditions, issuing permits and inspecting for compliance. Approximately 250 Shoreland Alteration Permits are issued annually by Regional Biologists. About one-third of the permits are issued for culvert and bridge installations, and one-quarter for cable and small diameter pipeline crossings. The remainder are issued for such things as bank stabilization at lake and river front properties, mineral exploration drilling programs near lakes, boat launches, repairs to dams and weirs, and beach developments.

In addition, Conservation Officers issue approximately the same number of permits for minor shoreline work such as sand deposit above the high water line.

Enforcement activities are carried out by Conservation Officers with support from Regional Biologists. Emphasis is on compliance, with court action usually taken only in cases of noncompliance. Regional staff are also involved in the environmental impact assessment process and development of compensation agreements.

Current Issues

Road crossings - Saskatchewan has the highest density of roads in Canada. Most road construction occurred before permits were required for stream crossings. In addition, current stream crossings almost always use culverts due to cost considerations. Proper design and placement of culverts is critical to ensure fish passage. As a result, fish passage at road crossings and the resulting fragmentation of habitat is a major concern.

Whole lake destruction - Mining activities in northern Saskatchewan have impacts on fish habitat in several ways. Frequently, ore bodies are found under water bodies and portions of lakes or entire lakes are dewatered to allow mining to occur. Lakes may also be used for disposal of tailings or waste rock or for use in waste water treatment systems. In all cases, future use by fish is precluded. The No Net Loss Policy provides a mechanism for compensating for this loss of habitat but suitable compensation for the loss of an entire lake is difficult to determine and to carry out.

Application of the No Net Loss Policy in northern Saskatchewan - Application of this policy in northern Saskatchewan is difficult and often impractical. Most of the major habitat destruction in Saskatchewan occurs in the north. However, with the abundance of lakes in this area, any habitat compensation work adds an insignificant amount of habitat to what is already available in the area. Habitat development needs are much greater in southern Saskatchewan but carrying out compensation work in the south for destruction that occurred in the north is unacceptable to northern residents.

Stream buffers/riparian areas - In northern Saskatchewan, the forest industry is attempting to gain access to timber in riparian areas. In southern Saskatchewan, agriculture has affected or removed riparian cover due to cropping and cattle grazing. Fisheries concerns are related to the function of riparian areas in protecting stream and lake habitat. However, concern goes beyond impacts to aquatic habitat to include concerns for the impact of vegetation changes on terrestrial biota that depend on these areas. SERM maintains control over riparian areas in provincial forests but most land in southern Saskatchewan is privately held and control of activities along streams is difficult.

Wetland drainage - Widespread drainage of sloughs has occurred across southern Saskatchewan over the past several decades to increase agricultural acreage. As a result, the increased spring runoff causes erosion and sedimentation in streams, affecting fish habitat. Also, increased flow volumes at culverted road crossings affect fish passage.

Channelization - Cumulative changes to the landscape, including wetland drainage and bush clearing, have led to increased volume and intensity of flow on many rivers. As a result, downstream flooding of agricultural land occurs and local governments and farmers attempt to increase conveyance capacity through stream channelization.

Dams - Dams have been constructed on most rivers in southern Saskatchewan. Very few allow for either upstream or downstream fish passage, resulting in fragmentation of fish populations and fish habitat. Downstream impacts of regulated flows can be severe, for example, the E. B. Campbell Dam on the Saskatchewan River has been implicated in the decline of the lake sturgeon population in the lower Saskatchewan River.

Lack of integration - Many different agencies are involved in water management in Saskatchewan. Conflicting mandates and programs often result in one agency encouraging activities that conflict with the mandate of another agency and may result in damage to fish habitat.

Emerging Issues

Issues related to landscape scale activities will increase in profile in the future. In the past, attention has been focused on site specific issues such as lake front developments and stream crossings. With appropriate guidelines, permitting requirements and public awareness, these issues are coming under control. However, broad scale activities on the land that affect fish have not been adequately addressed. Many of these issues are not strictly fish related but affect other components of the aquatic ecosystem as well as terrestrial and riparian habitats. Issues include the impacts of activities such as wetland drainage, forest harvesting and agricultural practices.

Problems at the landscape scale require attention from a variety of agencies and therefore require an integrated management approach so that each agency's programs are directed toward common goals. To be effective, management must also involve the stakeholders and landowners. Saskatchewan is moving toward this level of management through establishment of watershed management associations on several small watersheds.

Instream flow needs for fish have received very little attention in the past. Municipal, domestic, industrial and agricultural uses of water have taken precedence over fisheries needs. Irrigation demands are forecast to increase in southern Saskatchewan over the next few years. Several basin management studies now in progress are providing opportunities to introduce the concept of instream flow needs for fish. Increasing water demands for agriculture, industry and municipal water supply emphasize the need to reserve water supplies for instream use. However, in many locations, water supplies are largely allocated to other users and providing adequate flows for fish will be a challenge.

Information Needs

A defensible habitat rating system is needed that describes the relative value of different types of habitat for different species of fish. Such a system would allow comparisons of the value of existing habitat to altered habitat and created habitat. This would then allow values to be assigned to pre- and post-development habitat so that a numerical value can be assigned to the habitat loss. This would also allow flexibility in developing habitat compensation plans while ensuring that habitat of equal value is created.

Information is needed on the amounts of habitat of particular types that are required in a lake to maintain populations of different species of fish. This will enable better decision making when assessing project proposals that alter or destroy fish habitat. It will also allow better assessment of alternative compensation measures when destroyed habitat must be compensated for at off-site locations.

Information is needed on the importance of lower order streams, in terms of the species they support, their productivity, their contribution of forage fish to downstream fisheries and their effects on downstream water quality. Currently, lower order streams that do not support game fish receive little protection by either landowners or SERM. Knowledge of the value of these streams to the watershed and surrounding terrestrial ecosystems would allow better protection of these streams.

2.3 MANITOBA

Manitoba Habitat Management Overview

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Introduction

Fish habitat management issues arise primarily from the impacts of man's use and alteration of his natural environment. Within any province, key items such as its population size and densities, the amount of development (usually a reflection of population), and the amount of freshwater are indicators of the level of fish habitat issues jurisdictions may face. In this regard fish habitat in Manitoba has not had the degree of stresses that some of its sister provinces have had to face.

Manitoba has a small population of 1.2 million, of which 60% live in Winnipeg and 70% live in four urban centres. The province covers a relatively large area of approximately 650,000 square km., 15 % of which is water. One third of the water area is accounted for by three major lakes: Winnipeg, Winnipegosis and Manitoba. Manitoba's economy was built on agriculture. The services sector is now the largest contributor to the provincial economy but agriculture continues to be the backbone of rural southern Manitoba where both crop and livestock are important sectors. In northern Manitoba mining, forestry and hydro electric development, industries that can alter fish habitats, are important sectors of the economy. Over the past several decades agricultural related activities in the south and hydro electric development in the north have most significantly altered fish habitats in Manitoba.

Manitoba's Fish Habitat Management Goal, Objectives and Policy

Under the *Canada Act* the Parliament of Canada has legislative jurisdiction for freshwater fish. However, Manitoba like the other prairie provinces has a proprietary interest in maintaining and enhancing fish populations and fish habitats within the province. This situation has resulted in a degree of overlap and duplication of effort between Manitoba and Canada regarding the management of fish habitat. While a bilateral agreement had been drafted several years ago which defined agreed-to federal-provincial roles and responsibilities, it was never signed. The *Fisheries Act* Amendments being proposed contain enabling legislation that will allow some delegation of habitat protection authority to the provinces. Once these amendments have been enacted fish habitat management agreements will follow which will clearly define the roles and responsibilities of the two levels of government. Notwithstanding this situation, Manitoba Fisheries Branch and the Department of Fisheries and Oceans (DFO) have worked fairly closely

managing fish habitat within the province. The fish habitat goal, objectives and policies of both jurisdictions are very similar.

Manitoba's fish habitat management goal, as outlined in its current FISH HABITAT STRATEGY, is *"healthy, productive and sustainable fish communities and habitats that provide opportunities to satisfy the recreational, commercial, aboriginal, and intrinsic fishery needs of present and future Manitobans"*. In working toward achieving this goal, Manitoba's fish habitat objectives are:

- To protect and conserve healthy fish habitats,
- To rehabilitate and enhance degraded fish habitats, and
- To develop new fish habitats.

Manitoba has accepted and adopted the principles of the federal government's Policy for the Management of Fish Habitat that encompass **no net loss** of productive capacity. We are in the process of writing and implementing a **Sustainable Development Strategy for Fisheries in Manitoba**. This strategy will include fish habitat policy statements which are consistent with and complement the federal Policy. This Sustainable Development Strategy for Fisheries will have broad public and stakeholder review and debate. It is anticipated that the Strategy will be completed within the 1999\2000 fiscal year.

Organization and Programs

Manitoba Department of Natural Resources is a decentralized organization. The province is organized into five administrative regions. Each region has a fisheries manager with anywhere from one to four support staff. The regional fisheries managers are responsible for the management of all aspects of the fisheries within their respective regions including the delivery of fisheries management programs. The enforcement of fisheries related legislation is also carried out by the regional Natural Resources Officers.

The fish habitat head office function focuses largely on policy and program development, administration of the Manitoba Fisheries Enhancement Initiative, and providing support for regional fish habitat initiatives. A staff of three biologists and three technicians fulfil these head office functions.

Since the early 1980's Manitoba has focused on reducing the size and cost of government. Fisheries habitat management staff and operating budgets have been reduced significantly since that time and have stabilized in the 1990's. Fisheries management sections in other jurisdictions have gone through or are going through similar exercises. In these reductions, the areas of research and monitoring tend to be hit first and hardest; however, the impacts of these reductions to fish habitat management are not necessarily felt immediately. Research, monitoring and analysis necessary for well-informed decision making is lacking and existing information and data become dated and diminished in value.

Habitat Protection Programs

In working toward the objective of fish habitat protection, Manitoba fish habitat managers fulfil a number of roles and functions including:

- Representing fisheries habitat interests in
  - the licensing process under the *Manitoba Environment Act*,
  - crown land use, management, and development,
  - municipal planning and development;
- Providing information to industry on the requirements for fish habitat protection,
- Planning, policy and guideline development,
- Habitat assessment and monitoring,
- Providing information to and informing developers, private organizations and the general public on the value and importance of fish habitats and on fish habitat issues,
- Maintaining fish habitat information systems,
- Developing and transferring fish habitat protection and impact mitigation technology,
- Liaising with private and public agencies involved with aquatic ecosystem protection,
- Monitoring and controlling the importation and transport of aquatic organisms within the province.

The majority of fish habitat protection effort is consumed in the review and assessment of license applications under the *Manitoba Environment Act* and in crown land management and development. Currently the most effective means for administering and enforcing our fish habitat protection program is through conditions of licences under the Manitoba Environment Act and conditions of permits under the provincial *Crown Lands Act*.

Habitat Rehabilitation and Development

In working toward enhancing, rehabilitating and creating new fish habitat the roles we play include:

- Developing habitat enhancement and rehabilitation plans on a watershed basis,
- Designing, co-ordinating, supervising, and evaluating habitat enhancement and restoration projects,
- Conducting habitat inventory surveys,
- Liaising with private and public agencies involved with fish habitat and fish habitat enhancement,
- Establishing partnerships with other agencies, user groups and individuals to plan and finance habitat enhancement and rehabilitation initiatives,
- Providing information and consultative services to the public and private sector on rehabilitation and enhancement techniques.

Manitoba has been focusing on a watershed approach to deliver its habitat enhancement and restoration programs especially in Agro Manitoba. This contrasts the more "shotgun" approach taken in the past where limited Fisheries Branch Habitat resources were spread around the province. We have gone through a process of prioritizing watersheds in Agro Manitoba based on a number of criteria, such as level of habitat degradation, rehabilitation potential and stakeholder interest. We then focus on the high priority watersheds, work with the local watershed group, develop a watershed plan and commit significant resources to those watersheds for a three to five year period.

The most significant funding source for fish habitat enhancement and restoration work in Manitoba is the Manitoba Fisheries Enhancement Initiative (FEI). The FEI is designed to make funding available to non-government organizations for projects and activities that will enhance, rehabilitate or develop fish habitat and fish populations in Manitoba. The funding of this initiative is linked to the mandatory sale of a $2.50 fisheries enhancement stamp with each fishing license sold in Manitoba. Approximately $350k is budgeted annually for this program.

It is through this program and partnerships with other agencies, such as DFO and the Canada-Manitoba Agreement on Agricultural Sustainability, and local stakeholder groups that we have been able to accomplish the majority of habitat restoration and rehabilitation work in Manitoba over the past several years.

Issues, Challenges and Information Needs

The agricultural industries in Manitoba are in an accelerated growth phase. This is evident from:

- Agriculture's target of an additional 30,000 irrigated acres of potato production over the next few years;
- Increased investments in agriculture-based industries such as the alfalfa pelleting plant at St. Agathe and the straw board plant at Elie;
- Recent expansions in the food processing industries such as McCain's, Schneider's and most recently the Maple Leaf hog processing plant in Brandon;
- Projected increases in the number of livestock, specifically a doubling of hogs, produced in the province over the next few years.

The expansion of agriculture and agriculture industries have the potential to impact fish habitat in the following ways:

- Water quality impacts by creating additional sources of nutrients, nitrates, ammonia, salts, pesticides and sediments,
- Increased demand for off stream water use, both surface and ground water,
- Increased demand for more and improved land drainage,
- Increased land clearing and potentially reduced riparian areas,
- Increased instream and off stream water storage.

Of these issues, the single largest issue in the next decade in Agro Manitoba will be water allocation.

In the north there will be issues associated with growing and expanding forestry and mining operations. The move by the forest industry to a harvest strategy mimicking natural disturbances will impact our approach to buffer management. Hydro electric development will require habitat managers to more effectively quantify habitat loss or alteration and define acceptable compensation.

The challenge for fish habitat management in Manitoba is to protect and maintain fish habitat in the face of increased growth and development with existing or fewer resources. Some specific challenges and needs include:

- Maintaining instream flow reserves for fish habitat in Agro Manitoba,
- Maintaining fish habitat quality, quantity and diversity in streams, lakes and wetlands,
- Maintaining enough fish habitat and fish production to meet present and future demands for fish,
- Maintaining biodiversity,
- Developing better tools and methods for assessing habitat quantity and quality,
- Defining acceptable compensation measures and tools to assess their effectiveness,
- Defining and identifying significant habitat values,
- Working with proponents and developers in a more collaborative manner rather than adversarial. In many cases the proponents and developers have more resources to direct at research and assessment than the regulatory agencies,
- Applying ecosystem based management,
- More effective methods for having the public accounts take into consideration and account for a natural capital such as fish and fish habitat.

2.4 ONTARIO

Ontario Habitat Management Overview

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BACKGROUND

In July 1988, Canada and Ontario signed the Canada-Ontario Fisheries Agreement (COFA) which recognized the shared responsibility of the two levels of government in fisheries management within Ontario. The signatories agreed to develop a number of subsidiary agreements that would clarify their respective roles and responsibilities in managing the province's fisheries. The following March, the federal and provincial governments signed the Canada-Ontario Memorandum of Intent on the Management of Fish Habitat (MOI). The MOI outlines the intent of the two governments to develop a habitat subsidiary agreement that would clarify the administration of the habitat provisions of the *Fisheries Act*, specifically Section 35(2).

The MOI committed Ontario to aim for the objectives of the 1986 federal Policy for the Management of Fish Habitat by applying the following strategies:

1. Protection and Compliance
2. Research
3. Habitat Inventory and Monitoring
4. Habitat Rehabilitation and Development
5. Co-operative Action
6. Integrated Resource Planning and Management
7. Education, and
8. Public Consultation.

Working groups were formed to develop the first four strategies, but none were finalized for approval by CONFAB, the Canada-Ontario Fisheries Advisory Board.

As an interim arrangement until the legal steps could take place for the formal delegation of authority under Section 35 of the *Fisheries Act*, Canada and Ontario in May, 1989 agreed informally to an "Interim Referral Process" whereby the province reviews proposals and issues work permits and approvals in situations where habitat will not be harmfully altered. Where habitat destruction cannot be prevented, proposals are referred to DFO for authorization under the *Fisheries Act* and agreement of appropriate compensation. This "interim" arrangement had been in effect for over 8 years with the agreement not being signed by either party, until Ontario withdrew from this process on September 18, 1997.

In addition to the Interim Referral Process, the Ontario Ministry of Natural Resources (OMNR) and the Fisheries and Habitat Management Branch at DFO Burlington have worked co-operatively in the past in other areas. A five module training program has been developed which includes manuals, videos, interactive computer software and guidelines to be used for staff training in fish habitat protection. Additionally, guidelines dealing with pipeline water crossings and groundwater issues, and fact sheets on shoreline development, have been developed for the public, outlining how to protect fish habitat. Public understanding and awareness has also been increased by fish habitat displays used at local meetings and outdoor/cottaging shows.

Prior to 1997, OMNR reviewed thousands of projects each year and issued work permits under the Provincial Lakes and Rivers Improvement Act and Public Lands Act. A large percentage of these projects involve work around the water such as dredging, stream crossings, docks etc. Consequently, these projects were also reviewed with regard to requirements of the *Fisheries Act* Section 35(2).

PRESENT ACTIVITIES

Recent restructuring within the Provincial Government has seen the numbers of work permits issued and the technical staff to review them reduced significantly. In 1996, regulatory changes were made to the Lakes and Rivers Improvement Act and the Public Lands Act as part of the "Red Tape Reduction Initiative". These regulatory changes removed the requirement for a work permit for some low risk activities.

Some activities which no longer require a permit include:

- installation of heat loops, cables, water lines,
- floating structure (docks, boathouses, rafts),
- structures on posts/stilts,
- docks/ boathouses with < 15 m^2 in surface area of cribbing,
- aquatic plant removal in areas of the province with abundant plant growth, and
- water crossings draining areas < 5 km^2 and enclosing streams < 20 m long.

Some of the activities that still require permits include:

- docks and boathouses built on solid structures,
- dredging and filling,
- groynes, breakwalls,
- water crossing draining an area > 5 km^2,
- water crossing enclosing streams > 20 m.

The activities that still require a permit were selected because they either cause significant environmental effects or pose a risk to human life.

All timber management activities, including water crossings related to logging, are now covered under the recently passed *Crown Forest Sustainability Act*, and work permit conditions are being replaced by conditions or standards written in forest management plans.

No conditions presently apply to mineral exploration, but OMNR is involved with the federal initiative to update the Code of Practice for Mining which should develop Best Management Practices (BMPs) for mineral exploration. OMNR is providing input to the Environmental Effects Monitoring (EEM) program that is being developed for the new regulations under the Fisheries Act for metal mining effluents.

A referral mechanism is in place for OMNR to advise proponents of potential requirements under section 35 of the *Fisheries Act*. OMNR does not issue work permits until DFO has provided advice on or authorization of fish habitat projects. DFO now administers the habitat protection provisions of the Act directly. OMNR still continues to enforce all sections of the *Fisheries Act* except for section 35. Discussions are on-going on finding a solution to applying and enforcing the habitat protection provisions of section 35.

Reforms to Ontario's land use planning system, introduced under the Planning Act on May 22, 1996, give municipalities greater authority in decision making around fish habitat. At the same time, planning authorities must now have regard to the Natural Heritage Policy (Policy 2.3) contained in the Provincial Policy Statement issued under the Planning Act. To assist municipalities in their new role the Ministry has provided them with a number of tools to assess the risk of damage to fish habitat from development proposals submitted under the Planning Act. To date Natural Heritage training manuals and local fish habitat information have been provided to municipalities.

OMNR supports and works with the Ontario agri-food sector, through Ontario's Ministry of Agriculture, to help this sector develop best management practices that sustain fish and wildlife resources on farmlands. OMNR has contributed to the Environmental Farm Planning Process (over 12,000 farmers have developed farm plans); BMP booklets on Fish and Wildlife (F&W) management, water management and nutrient management; a workshop on water taking and agriculture; the Livestock Manure Pollution and Prevention Pilot project and a nutrient management planning process to address the growing feedlot industry. In addition, OMNR supports and is working with DFO in Burlington on a class authorization approach for agricultural municipal drains. This approach classifies drains according to their sensitivity to fish habitat and greatly streamlines the review process.

OMNR worked with DFO on developing DFO's 1997 guidance document for road maintenance activities so road managers can avoid conflicts with the Fisheries Act. OMNR and DFO continue to work together with Ontario Hydro to protect fish stocks and habitat at Hydro's facilities.

OMNR has strengthened its Community Fisheries Involvement Program (CFIP) under the new F&W Business Plan to enable more partners to participate and increase the profile of this successful program. In 1997-98 there were 134 fish habitat rehabilitation projects of the 268 approved projects totaling $648,000, at an average project cost of $2,418. Partnerships to protect fish habitat are also being created with Ducks Unlimited, major farm organizations, the

Ontario Federation of Anglers and Hunters, tourist camp operators and cottage associations at both the individual water body and watershed scale.

Fish and Wildlife continues to be one of the priorities of OMNR. The recent Ontario budget announced an additional $10 million dollars for F&W protection and enhancement.

OMNR is initiating a Natural Resources Values Information System to provide the tools for a GIS approach to land information and mapping of resources in Ontario.

OMNR supports fish habitat research in:

- Developing a smallmouth bass habitat supply model;
- Impact on fish stocks of habitat loss versus harvest;
- Riparian use effects on fish and invertebrates;
- Relationship between watershed geology and structure and fish community distribution;
- A whole lake habitat manipulation;
- Effects of climate and zebra mussels on changing cold water fish habitat;
- A sampling protocol for littoral zone habitat;
- Fish habitat classification;
- Impacts of shoreline disturbance on fish habitat;
- Developing lake trout dissolved oxygen criteria;
- Assessing the impacts of low-head barriers on stream fish communities; and
- Water yield impacts associated with timber harvesting and road construction.

EMERGING ISSUES

Will fish habitat be protected with changes in government roles and increased responsibility for fish habitat protection being delegated to timber and mining companies and municipalities? OMNR needs to define its role with reduced staff and new technologies, and the role of conservation authorities in fish habitat management.

How can we ensure fish habitat research is incorporated into OMNR's policies and direction to staff and others? There needs to be coordination and cooperation between MNR and DFO research in Winnipeg (Experimental Lakes Area), Sault Ste. Marie and Burlington.

Interest in underwater log salvage is increasing, and guidelines need to be developed to ensure fish habitat (cover) and water quality (disturb contaminated bottom sediments) is protected.

Water crossing removal criteria for abandoned logging roads needs to be implemented through developing road use management strategies in forest management plans to reduce the incidence of road washouts.

There is an increasing public scrutiny of government decisions; for example, many government decisions have to be posted on the Environmental Bill of Rights Registry. Some environmental groups are reviewing forest management plans and activities in the field to see if they conform to government legislation. If not, these groups are taking the government and timber companies to court to rectify the situation.

The situation dealing with fish habitat in Ontario needs to be resolved, and harmonization and/or delegation of responsibility between the two levels of government need to be decided. This requires revisions to the *Fisheries Act*, re-introducing the Bill in the House, and developing criteria to clarify when the *Fisheries Act* triggers the CEAA.

Ontario needs an aquatic habitat classification system in order to ensure all aquatic natural heritage values are represented and protected through land use planning exercises such as Ontario's Lands for Life.

There is increasing interest in developing watershed plans in North America, and governments should be looking at managing fish habitat and fisheries on a watershed basis.

2.5 DFO HABITAT MANAGEMENT

DFO Habitat Management Division - Habitat Management Overview

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Central and Arctic Region
Winnipeg.

The Department of Fisheries and Oceans' (DFO's) Central and Arctic Region represents approximately 64 per cent of the surface area of Canada, encompassing four provinces and the Northwest Territories (NWT), Nunavut and the North Slope of Yukon. The region contains about 67 per cent of the country's freshwater and seven of the 14 largest lakes in the world and is bounded by 71 per cent of Canada's coastline. The majority of the country's population lives in this region and the Region supports the bulk of the recreational fishers and pleasure boaters. In the NWT and Nunavut, the Region is responsible for full Departmental program delivery, while in the provinces, the Federal Government has delegated fisheries management responsibilities to provincial government agencies, while retaining habitat management functions. DFO's Habitat Management Division (HMD) activities are administered from offices in Winnipeg, Burlington, Yellowknife and Iqaluit.

The past 12 months have brought about significant changes in the direction and day-to-day operations of the HMD in this region. Proposed amendments to the *Fisheries Act* and the state of discussions with the provinces regarding the delegation of habitat responsibilities, have created a political atmosphere in some areas which has instigated an exponential increase in workloads. This situation has necessitated large and immediate increases in the numbers of professional staff as well as a shift in focus of DFO's enforcement activities.

This has occurred during a time when the economic climate in the country has been extremely favorable for industrial, agricultural and municipal development. The current availability of capital and the potential of lucrative returns have promoted these sectors to initiate projects and expansion activities at an unprecedented rate. Rapidly changing technology has also had an obvious influence on project activities in the region. This has resulted in significant challenges to habitat managers not only from the perspective of the huge increase in the number of project referrals, but in the nature and scope of the projects being proposed. Who in the recent past would have predicted whole lake destruction due to diamond mining in the NWT or that seven lease areas in northern Alberta would come on line for Oilsands extraction almost simultaneously?

While the private sector has recently been enjoying prosperous economic times, government agencies, both federal and provincial, have been targets of downsizing, rightsizing, reorganizing and outsourcing. Departmental objectives, mandates and programs are being reevaluated, in

many cases in the context of a business environment, in order to rationalize program delivery and provide what is perceived as a more publicly accountable service. These factors have all greatly influenced the nature of emerging habitat management issues.

Aside from our direct habitat responsibilities, the proclamation of the *Canadian Environmental Assessment Act* (CEAA) in 1995, placed an increased burden on federal habitat managers to assess all environmental impacts of projects requiring authorizations pursuant to the habitat protection provisions of the *Fisheries Act*. CEAA further requires that these assessments be undertaken prior to the relevant federal regulatory agencies taking any action such as issuing an authorization, permit or approval. The complexity of these assessments may range from relatively simple screenings to public panel reviews involving participation by multiple federal agencies, provincial agencies, non-government organizations and members of the general public. In most cases, more time and effort is expended satisfying the requirements of the CEAA, than processing the project proposal under the *Fisheries Act*. As a lead federal agency responsible for coordinating a panel review for a major project, the general rule is to count on dedicating at least one person-year (PY) to that project exclusively. As well, environmental organizations are now viewing the *Fisheries Act* not as legislation for fisheries and habitat management, but as broad environmental protection legislation because of the links to the CEAA. These groups are now mounting numerous court challenges in order to force DFO to invoke the *Fisheries Act* and undertake the associated environmental assessments. The repercussions of this to HMD operations become obvious.

A further complication to our lives as habitat managers arises from the fact that many of the potential impacts to fish habitat are brought about by new technology and as such, may be unique and in some cases may not have been anticipated. As habitat managers, we are required to learn and adapt to these changes and challenges at an equally rapid pace. Perhaps one of the best ways to accomplish this is to share our knowledge of these issues and collectively develop solutions or at the least clearly identify our information needs. To this end, it must be highlighted that working relationships between individuals of federal and provincial management agencies in our region have been and continue to be for the most part, cooperative and professional.

The topics summarized in this binder, for discussion at the workshop, generally appear to represent a common list of emerging issues for all jurisdictions within the region. Granted, each area has project or sector specific concerns which are determined by the geographical distribution of particular resources, but often, common habitat issues persist.

In canvassing Area Habitat Coordinators in the region, it became apparent that **stream crossings** associated with linear developments such as transportation corridors and pipelines still represent an area of significant concern, as well as a large portion of the total referral workload. This concern was not due to a lack of information or guidelines regarding potential effects or the construction methods or mitigation, but mostly with the lack of consistency in application of this information not only between, but also within jurisdictions. This is particularly relevant in large scale linear developments which might span multiple provinces or regions. Due to the sheer numbers of these types of referrals, some area offices have developed standard or "class" review

procedures, conditions of approval or information requirements to aid in meeting the conditions of both federal and provincial regulatory processes. It seems reasonable to speculate that other areas or jurisdictions might benefit from sharing this type of information and with some discussion, consistency of application could be improved.

Habitat issues related to **agricultural activities** are common to prairie areas as well as Ontario, although the nature of the activities is diverse. These range from free range cattle grazing in the foothills of the Rockies to feedlots, irrigation projects and dairy operations to mention only a few. Each of these has its own specific concerns and problems for habitat managers. Some excellent multi-stakeholder initiatives, such as the Riparian Habitat Management Project in Alberta, have been successful in educating ranchers and other resource managers on the problems associated with uncontrolled grazing in riparian areas as well as the potential mutual benefits which could be derived from a managed grazing regime. This is only one illustration of "self-regulation" in action and admittedly, this approach works best when there is a demonstrated improvement in the "bottom line".

With respect to **irrigation projects**, earlier comments regarding changing technology are particularly relevant, since the modeling of instream flow needs (IFN) is evolving faster than most of us can follow, let alone comprehend. IFN is also a key component in assessing the effects of hydro electric generation facilities on fish and fish habitat. Once again, we are faced with the problem of different jurisdictions and regions using different techniques for calculating or modeling IFN. Although it would seem advantageous to adopt a standard IFN method, given the range in conditions and species of concern as well as the rate of change in the science, this may not in fact be feasible.

Another common and significant issue facing habitat managers in this region is **forest management**. Not only are the potential effects on fish habitat a concern due to the physical size of the forest management areas involved, but as well, there is an increasing amount of public concern regarding the impacts of forest harvesting. It may only be a matter of time before habitat managers will be expected to quantitatively address related issues such as drainage area harvest versus hydrology or buffer strips versus ecologically based management. Unlike some of the previous issues, those related to forest management may require a significant amount of additional scientific investigation before some meaningful or defensible guidelines can be developed or implemented.

Resource development based projects are obviously not the only assaults on fish habitat. All of the areas within the region where **urban and/or recreational development** activities occur, are candidates for fish habitat degradation. Ontario, due to its comparatively large population and resulting urban sprawl, by far leads the way in the volume of these types of activities. Developers appear to believe that meandering streams in highly populated areas occupy too much valuable land area and need to be channelized and armored. Most of their floodplains are developed and paved, with obvious consequences to the hydraulic regimes of these basins. Golf courses next to flood prone rivers must be protected, as waiting for the water to recede and cleaning up after would seriously shorten the available golfing season. Cottage owners who escape the cities to seek more rustic surroundings, remove trees and brush for lawns and septic

fields. Shoreline vegetation that block the view of the water is usually the first to be clear-cut. Consolidation of existing guidelines and good public education programs are likely the first line in addressing these types of issues.

As mentioned previously, each of our area offices has identified a number of projects that are, at least currently, specific to their geographical location. There are, however, many emerging habitat issues relevant to these projects that are common to other project categories in other areas.

Open Pit Oilsands Mining

These projects involve huge surface area disturbances in northern Alberta. Processing of the material results in atmospheric releases of acid precursors of SOx and NOx as well as the deposition of deleterious materials into tailings ponds which may not be located in impervious basins. In addition to direct physical disruption of streams, these projects may potentially alter groundwater regimes which could in turn affect stream hydrology. On a project by project basis, these effects on fish habitat may be manageable, however, given that the economic climate is favorable, seven such lease developments are proposed almost adjacent to one another yielding a combined area of disturbance which will involve a huge land area. The cumulative effects of these combined projects occur on a regional scale and thus the assessment of the impacts should be undertaken in that context. This raises some interesting questions. For example, how are the spatial boundaries for a regional assessment established? At what point do insignificant individual effects accumulate to become significant, or how do we establish or invoke thresholds? When do cumulative impacts become a HADD? Who is responsible for establishing and maintaining regional scale monitoring programs? The answers to these questions may be beyond the scope of this workshop, however, they do represent real concerns to habitat management staff.

Open Pit Coal Mining

Development of open pit coal mines also typically involves disturbance of large portions of watersheds along with the many associated fish habitat impacts. In the mountainous terrain of western Alberta, the orientation of the coal seams may result in a number of pits being developed in conjunction with a single mine operation. Disposal of rock overburden removed to access the underlying coal, presents a problem in this irregular terrain. Most often, river valleys are chosen as sites for rock dumps for a variety of logistical reasons and reclaiming this material to back fill exhausted end pits may not be possible, or at the least, is very costly. The remaining end pits eventually fill with water and become very deep, very oligotrophic lakes. At the same time as lakes are being created, streams are being lost through burial under waste rock dumps or through pit development. It is not surprising that lake-for-stream habitat replacement (habitat transfer) became the preferred method proposed by coal companies to satisfy the No Net Loss (NNL) principle. Obviously there are a number of concerns to be addressed before this approach to compensation is embraced by habitat managers.

Uranium Mining

As with many other types of mining operations, uranium mining generates large amounts of waste rock that was initially most conveniently disposed of in lakes located near the mine site. The waste rock, as well as tailings from the operation, have the potential to produce or mobilize a host of chemical contaminants which may be toxic or may contaminate fish flesh. There have been instances where lakes have been allocated as disposal sites and compensation for the lost habitat has been negotiated, raising issues pertaining to the acceptability of compensation for whole lake destruction, off site compensation and habitat replacement. As with the previously described projects, uranium mining creates large scale disturbances within watersheds which may impact habitat directly or through modification of the basin hydrology. Much of the current focus with respect to uranium mining is on the decommissioning and reclamation of old mine sites and the re-establishment of fisheries values and resources.

Diamond Mining

As a comparative newcomer to the list of habitat insults in our region, diamond mining shares many of the above concerns with the interesting variation that most of the diamond bearing substrates are located under lakes. Currently, draining the lakes to access the ore is the only viable technique. Once again, compensation for whole lake destruction has become a major issue associated with this type of project. Other concerns are similar to those encountered in other mining operations.

Timber Salvage

In recent years, the prices of construction lumber and pulpwood have increased to a point where salvaging logs from rivers and lakes has become economically attractive. At least in Ontario, this has developed into a significant concern for habitat managers, and a workshop was recently conducted to identify related concerns and to develop guidelines for resource managers and proponents.

The foregoing discussion was not intended to be a comprehensive synopsis of all possible impacts to fish habitat or concerns of habitat managers relevant to all types of projects in the region. The details will likely emerge through discussions during this workshop.

In addition to the technical issues plaguing habitat managers in the region, there are some fundamental operational issues that should be discussed in order to move us toward potential solutions.

A basic concept underlying the habitat provisions of the *Fisheries Act* and the Policy for the Management of Fish Habitat is that of "Harmful Alteration, Disruption or Destruction" (HADD) of fish habitat. There is no sense in pretending that an unambiguous and universally accepted definition of HADD has been adopted, or even exists. Within our own jurisdiction or even within our own region, there are differences in the definition of HADD, so it is not

surprising that when we deal with fisheries and habitat managers in other jurisdictions, this discrepancy persists. It goes without saying that if we are all viewing HADD from different perspectives, then defining and achieving NNL may be somewhat problematic. On the optimistic side, these concerns have been identified and acknowledged and our department is moving toward developing guidelines and scientifically based procedures to be used in addressing these issues. It is critical that this is not done in isolation and that the relevant individuals from all jurisdictions participate in, and be kept informed through discussions such as these.

Last but by no means least, it is imperative that the issues of enforcement of the habitat protection provisions of the *Fisheries Act* and compliance monitoring be resolved between our respective jurisdictions. Recent annual reports to Parliament indicate that there have been few if any prosecutions pursuant to Section 35. This means that either we are collectively doing an admirable job educating others and no HADD is occurring that is not authorized and compensated for, or that prosecution for unauthorized HADD is not taking place. Unfortunately, these issues are going to be more difficult to resolve given the current political and administrative climate. In the mean time, there is no shortage of subject material to challenge our professional expertise and for which we may actually be able to exert some influence.

2.6 DFO SCIENCE

DFO Freshwater Habitat Science: An Overview.

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INTRODUCTION

The primary purpose of this report is tc provide a brief overview and introduction to freshwater habitat science, drawing on inputs from several colleagues in Central and Arctic Region of DFO. Activities within the Region receive closer attention as the Region encompasses the focus of this workshop on Prairies' issues and science needs. The report also provides a research-based perspective on the identification of science needs for the future, recognizing that habitat management and research groups are driven by different agendas and timetables.

Conventionally, management of fish and fisheries has been focused on the fish and those exploiting them. Management of the ecological systems providing the necessary living spaces and food resources, the habitat, for fish had received less attention. Environmental research and management have occurred with respect to contaminants, phosphorus eutrophication, and intentional introduction of food and sport species, although largely from a human-centered perspective. While fishing often places great strains on the ability of fish stocks to support desired yields and persist via natural productivity, other human activities encroach on and alter habitat productivity in many places, undermining the ecosystem's ability to sustain production. As efforts to address conservation and ecological sustainability issues have gradually gained more attention, there has been a growing recognition that habitat management must take its place within the domain of fishery management. While a substantial body of scientific knowledge and information about fisheries has been assembled over many decades, habitat science is still in the formative stages and much remains to be done.

A BRIEF HISTORY OF HABITAT SCIENCE IN DFO

Revisions to the *Fisheries Act*, strengthening the rules for habitat protection, and the subsequent release in 1986 of the federal Policy for the Management of Fish Habitat laid the ground for increased interest in developing the necessary science although few additional resources came with the Policy statement. The provision of the *Fisheries Act* prohibiting 'harmful alteration, disruption and destruction' (HADD) of fish habitat without a ministerial authorization and the

Policy's guiding principle of 'no net loss' (NNL) of productive capacity of fish habitats are clearly quantitative concepts and have posed a great challenge for science to provide the evidence and tools needed to effectively implement them.

As part of the Green Plan, DFO initiated a Habitat Action Plan (HAP) in the early 1990s involving both Science and Habitat Management elements. This program provided an important stimulus for habitat research across DFO until the funding expired in 1997. Despite down-sizing, some regions have been able to retain some promising programs with a mixture of funding sources. More recently, several habitat-related projects have been supported as part of DFO's Strategic Science Program.

Interest and activity in fish habitat science has been growing rapidly recently. In 1996, a supplement of the Canadian Journal of Fisheries and Aquatic Sciences, edited by Dr. John Kelso, reported on the proceedings of a workshop on 'Science and Management for Habitat Conservation and Restoration Strategies (HabCARES) in the Great Lakes. The papers and syntheses based on workshop discussions published in the supplement demonstrated the emergence of a science of fish habitat. The reports from a national DFO workshop on productive capacity held in 1996 (Levings et al. 1997) and a joint DFO-OMNR workshop held in Ontario in 1997 (Lester et al. 1997) provided further evidence of an upsurge in both science and management considerations of fish habitat across Canada. This current workshop focused on Prairie issues is further evidence of this expanded attention.

Most habitat management practice has developed haphazardly and largely remains a non-quantitative art despite the clear need for science-based, quantitative practices. In most jurisdictions, the delivery of fish habitat protection is uneven, depending heavily on the experience, judgement, and insight of the individual practitioners. Many of the measures that are routinely accepted as mitigation or compensation, e.g. 'like for like', are untested scientifically and the supporting anecdotal information has often not been assembled and evaluated.

RECENT AND CURRENT FRESHWATER HABITAT SCIENCE

This section provides a brief overview of freshwater science in Central and Arctic, and then more briefly other regions, of DFO. This is not meant to be an exhaustive identification of research activities past and present. Instead, the intention is to indicate the range and types of research and the kinds of issues being addressed with available, limited resources.

A number of individuals noted above in Central and Arctic Region provided much of the details in the following section and their help is gratefully acknowledged. The activities are marked as being old, on-going or new, and that marking helps give some sense of the progression in the research.

It should also be noted that the snapshot presented below is heavily weighted toward physical habitat science. Past and on-going research on contaminants, eutrophication, exotic species, and productivity in freshwater ecosystems has and is continuing to play a large role nationally and

internationally in the management of freshwater ecosystems. Researchers in Central and Arctic Region, in Winnipeg, Burlington, and Sault Ste. Marie, have been responsible for devising, conducting, reporting and interpreting that science. It is also important to note the extensive involvement of many C&A scientists over the years in a number of the large-scale hydro-electric, paper, mining, oil pipeline, oil sands, etc., assessment activities both as reviewers/advisors and as active research participants. In the physical science arena, people like Bob Newbury have been very active in the design and assessment of habitat alterations, especially in streams and rivers.

Central and Arctic Region

Defensible Methods of Assessing Fish Habitats - C.K. Minns, Burlington: (On-going)

The goal of this project has been to develop a software-based analytical tool for assessing the impacts of proposed development activities. Originally the tool was developed for application in the nearshore habitats of the Great Lakes. Now the project is expanding its scope into streams of southern Ontario and has a mandate to expand the lacustrine module to other regions of Canada with regionally-appropriate databases. Work has begun on a Newfoundland and Labrador module.

The basic assessment model is founded on the concept that habitat features used by many species and life-stages make a greater contribution to productivity, a contribution that can be expressed as a richness-related measure of suitability. Databases of species and life-stage habitat requirements are assembled from literature review. Where possible, suitability values empirically predicted from habitat features are compared with standardized fish catch data to provide a degree of model verification. The results are consistent with other forms of fish-habitat modelling. Other measures of productivity are being developed and tested with a view to eventually adding them to the software system. The software implementation is consistent with a quantitative framework for assessing NNL developed by Minns (1997). The project has developed with substantial input from habitat management staff using current referrals. The Great Lakes lacustrine software and database are now routinely used to evaluate proposed nearshore developments.

The eventual goal is to market the 'Defensible Methods' software for use by proponents of development and by those mandated to conserve and protect fish habitats. With supporting training and scientific and technical documentation, users should be able to use the tool to guide the design of developments minimizing negative habitat impacts and attaining the policy goal of 'no net loss'.

The Defensible Methods approach also has potential for use in the development of area fish habitat management plans, as identified in the habitat Policy document but little acted on to date. Such plans will allow fish community and fish habitat objectives to be integrated and will allow rare and unique habitats to be protected. Such an application is currently under way in Severn Sound on Georgian Bay. Similar applications have been developed in Hamilton Harbour and are being developed as an aid to ecosystem management on Lake Erie. These plans, implemented with appropriate habitat inventories, can be linked hierarchically with landscape, biodiversity, and ecologically sustainable development planning.

***Productive Capacity of Fish Habitats - R.G. Randall, Burlington*: (On-going)**

The goal is to develop predictive models which link productive capacity to specific habitat characteristics in nearshore areas of the lower Great Lakes. A large fish-habitat database has been established and documented, covering both altered and unaltered sites at protected and (to a less extent) exposed coastal areas. Preliminary fish-habitat linkage models have been developed, key habitat indicators have been identified, and the accuracy and limitation of the models have been considered. Future work will:

1. Validate and revise the preliminary fish-habitat models;
2. Provide productivity indices for Defensible Methods;
3. Fill data gaps with additional field sampling; and
4. Derive general habitat classification schemes for the lower Great Lakes.

Field data are also being used to validate suitability indices generated by Defensible Methods. Results will be useful to habitat managers in the lower Great Lakes and elsewhere.

Fish Habitat Research Projects - J.D. Fitzsimons, Burlington:

Several connected areas of study have been pursued:

1. Spawning habitat requirements of lake trout (Old): Over a number of years various aspects of spawning habitat selection and use have been investigated with emphasis on the Great Lakes. This has included substrate arrangement and size, water quality, fetch, type (artificial, natural), location (nearshore, offshore, reefs), predators, genetics, egg and fry survival. Spawning occurs on the uppermost parts of reefs immediately adjacent to the drop-off, an area having high interstitial depth and minimal infilling. Site selection was unaffected by substrate size although artificial reefs had greater spawning activity than natural sites. Nearshore sites have greater spawning activity than offshore sites. Selection of spawning habitat appears to involve genetic factors. Survival of eggs and fry is related to fetch and stock effects.

2. Effects of zebra mussels on spawning habitat selection by walleye and lake trout (Old): Studies were conducted in Lakes Ontario and Erie to determine if the presence of mussel encrustation affected spawning site selection. No effect of the mussels on site selection was detected for either species using a variety of field collections and habitat manipulation experiments. In addition egg survival appeared to be unaffected by the presence of the mussels based on the spawning sites examined.

3. The effect of biological habitat namely the prey fish on reproductive performance of top predators (On-going): Diets dominated by either smelt or alewives resulted in depressed thiamine in the tissues, including ovaries, of top predators. This effect is unrelated to thiamine content of the prey but rather is likely mediated by the high thiaminase content of the smelt and alewives which when activated as a post mortem change in the gut destroys thiamine. If thiamine levels in eggs fall below a critical threshold there is a marked increase in the occurrence of early mortality syndromes and changes in yolk sac utilization of developing fish larvae.

4. The effect of artificial reefs on fish abundance in Hamilton Harbour and interactions with temperature and dissolved oxygen (Old): Artificial reef clusters placed in Hamilton Harbour as part of the Remedial Action Plan (RAP) had the effect of increasing abundance at the reefs but only in the fall when dissolved oxygen was adequate and temperature was above 5C. In the early spring abundance was low because of fish being nearshore to spawn while in the late fall abundance was low either because of reduced fish activity or catchability of the traps used. During the summer abundance was also low and was associated with upwelling induced anoxia in the area of the reefs.

5. Habitat requirements for spawning Atlantic salmon and overwinter survival in Lake Ontario tributaries (New): Radio-tagged fish were tracked to determine spawning locations in the Credit River. These natural redd sites along with artificial redds constructed in the same area were used to monitor overwinter survival which was then related to water and sediment quality.

Prairie and Experimental Lakes Area (ELA) Fish Habitat Research - W.G. Franzin, Winnipeg:

Several related areas of study have been pursued:

1. Mapping and quantification of nearshore fish habitats in small shield lakes at ELA with Paul Cooley (currently PhD student in Geography, UofM) using GIS (Old): All field work has been completed and Paul has finished his M.A. thesis and defence. We are writing 2-3 publications over the next several months to discuss methods, what can be learned about diversity of fish habitat in nearshore areas of shield lakes and effects of fetch.

2. Long-term low level research program on the abundance and biomass (ultimately productivity) of nearshore fishes in lakes using quadrat sampling techniques to estimate sampling requirements for above parameters (On-going): Requires funding to continue.

3. Abundance, species communities and habitat utilization of riverine fishes in relation to depth, substrate and velocity in small to medium sized rivers on the prairies using GIS (On-going): This project is a continuation of a Sustainable Fisheries funded project on the Assiniboine River. Additional studies may be possible on the Red River if funding from IJC materializes. Needs continued A-base funding.

4. Effects of pesticide applications in South Tobacco Creek (STC) drainage on stream fish community diversity and abundance (New): We will be looking at fish habitat in relation to stability of hydrology factors in annual and inter-annual time frame. Other streams will be examined to provide context of STC within the broader context of Manitoba escarpment streams. Assessment of physical fish habitat and riparian zones (as filters) is planned to begin this fiscal year.

5. Assessment of the Indices of Hydrologic Alteration software obtained from the Nature Conservancy in the US (New): I will be looking at flows in a number of prairie rivers

using this software to compare hydrologic regimes among rivers and in relation to long-term climate data.

Fish Habitat Research Programs - Drs. J.R.M. Kelso and K. Smokorowski, Sault Ste. Marie:
Several areas of activity include:

1. Gravel Pit and Quarry Reclamation (New): We will test the hypothesis that enhancement of physical habitat increases biological production and answer two key questions:
   a) Does any addition or increase in physical habitat result in a change to fish biomass, production or community structure?
   b) Is the effect mainly a redistribution of the fish that are there?

   DFO will work with the Aggregate Producers Association of Ontario and OMNR scientists in an attempt to reclaim abandoned gravel pits and quarries as productive water bodies. We'll determine the biological change, for a minimum of two years before and after treatment or manipulation, associated with reclamation options.

2. Experimental Manipulation of Habitat (New): We propose to determine the effect of nearshore habitat destruction and enhancement on the productive capacity of aquatic ecosystems in a cooperative DFO, Ontario Ministry of Natural Resources, and industry study. Treatments will include:
   - forest cover removal,
   - construction of permanent road access, and
   - removal of large woody debris.

   Meakin Forest Enterprises will construct roads and stream crossings, simulate cottage development and reduce nearshore diversity. The changes in fish stock, growth, and whole fish community production will be measured to determine the relationship between habitat and productive capacity in aquatic ecosystems.

3. Summary of Options and Benefits of Efforts to Rehabilitate or Mitigate lost Aquatic Habitat (On-going): A compilation of habitat improvement efforts was created to value each option in terms of cost, durability, biological effect, and aesthetics. An attempt to gather existing data on habitat enhancement, rehabilitation and creation efforts was completed through literature searches and personal communications. A technical report will include a summary of existing habitat rehabilitation and compensation projects and show the amount of assessment available for these fish habitat improvement efforts and analyze of the benefits of the rehabilitation options.

4. Great Lakes Cleanup Fund (On-going - Adds to Thunder and Nipigon Bay rehabilitation programs 1990 – 1996): There are five proposals for the St. Mary's River Area of Concern (AOC) to:
   i. Address the wetland rehabilitation and protection issue in the St. Mary's river. DFO will complete six wetland evaluations in the lower St. Mary's River and identify areas in Marks Bay and/or Leighs Bay in the upper St. Mary's where wetland and macrophyte enhancement would benefit fish and wildlife populations.

ii. Restore watershed conditions by instigating a community based process for rehabilitating riparian lands in Bar River, using a combination of fence construction, tree planting, streambank profiling, and creating alternate watering sources for livestock, all to stabilize flow and reduce downstream siltation.

iii. Facilitate a process for stakeholders and agencies to develop quantified delisting criteria for the St. Mary's River AOC.

iv. Rehabilitate an urban tributary in Fort Creek. Bank erosion and sediment loads continue to be a problem. Bioengineering and flushing of substrate in the upstream branches will improve water quality and esthetics in the reservoir and lower reaches. Eventual possibilities of creating spawning and nursery habitat for pacific salmonids or northern pike, creating a fishery for children, a wildfowl viewing area, and nature or interpretive walk will result downstream.

v. Work with first nations groups, tourism outfitters, and angling groups in the restoration of walleye abundance in the upper St. Mary's River. We propose to use radio receivers to track walleye with affixed radio transmitters to identify spawning locations and subsequently measure habitat used and evaluate where spawning habitat enhancement measures would be best placed.

5. Habitat and Sea Lamprey Larvae and Adult Spawning (On-going - Continuing studies 1993 – 1997): With the Great Lakes Fishery Commission (GLFC), DFO proposes to determine the compensatory mechanisms of the Great Lakes sea lamprey populations in order to evaluate the suitability of alternative methods to chemical treatments for suppressing sea lamprey abundance in the Great Lakes. This program will:
   - Determine the degree to which compensatory processes offset deliberate reductions in lamprey abundance,
   - Identify compensatory mechanisms, and
   - Determine whether climate and stream productivity affect the magnitude of compensation.

   As part of the compensatory mechanisms project we will determine the supply and utilization of spawning and larval habitat. The distribution and nest selection of adult lamprey will be evaluated subsequent to release of adult lampreys above barriers on two Lake Ontario streams.

6. Lake Habitat and Fish Biomass (New): Existing fish biomass/production data and habitat description data were collected from the Department of Fisheries and Oceans, Great Lakes Lab for Fisheries and Aquatic Sciences, the Ministry of Natural Resources, and the Algoma Fisheries Assessment Unit. Preliminary analysis of the data revealed that there are very large gaps in data collected to describe habitat features that might affect fish production/biomass. An investigation was begun to examine the methods of quantifying habitat features, at different scales, which may be of benefit to

understanding factors related to fish production/biomass. However, we will relate available measures of lake habitat (fetch, depth, watershed size, SDF, orientation to prevailing winds) to available measures of the fish community (catch per effort, species composition).

The Lake 226 Drawdown Experiment - Dr. D. Bodaly, Winnipeg: (On-going)

The purpose of the Lake 226 drawdown experiment, at the Experimental Lakes Area, northwestern Ontario, is to investigate the effects of winter drawdown on habitat productivity and fish populations by simulating the water level regimes in northern hydroelectric reservoirs. Water levels were drawn down over the winter by 2-3 m during three years; summer levels have varied from 0.7-1.5 m below natural levels. The water column of the lake has changed little due to drawdown, despite predictions of decreased light penetration and increased nutrients due to significant resuspension of bottom sediments. The littoral zone, in contrast, has been severely affected by drawdown. Benthic algal populations, aquatic macrophytes, and benthic invertebrates have all changed significantly. Lake whitefish spawning locations and substrate types were determined by acoustic tagging combined with substrate classification using GIS software. Whitefish were spawning on cobble substrate in shallow areas affected by drawdown and they have suffered year class failures since drawdown. The whitefish population has declined significantly due to weak reproductive success and due to high winter mortality in one year after drawdown.

The ELA Lake 191 Macrophyte Removal Experiment - Dr. K. Mills, Winnipeg: (On-going)

A macrophyte harvesting study was initiated in Lake 191 in 1996 to quantify the relationship between loss of macrophyte cover and change in productivity of northern pike. Secondary purposes were to quantify changes in other fish species in the lake as well as changes in other trophic levels and water chemistry. Two years of monitoring of lake chemistry and biota preceded the harvesting which was conducted using a commercial macrophyte harvester. Fifty percent of the macrophytes in littoral zone areas containing macrophytes were removed in 1996 and 1997.

Abundance of age 0 (young-of-the-year) northern pike decreased immediately after the initiation of harvesting in July 1996. The number of juvenile northern pike (< 300 mm) decreased in 1997, likely due to increased predation by larger individuals. Total abundance of northern pike decreased due primarily to loss of smaller individuals. Northern pike growth increased.

Yellow perch and pumpkinseed abundance increased primarily due to very successful year classes in 1997. The increased abundance of small planktivorous fishes caused the zooplankton biomass to decrease in 1997. Abundance of all size classes of zooplankton decreased.

Fish & Wildlife Habitat Restoration in Hamilton Harbour and Cootes Paradise - V.W. Cairns, Burlington: (On-going)

The Stage II Remedial Action Plan for Hamilton Harbour contained recommendations to improve the shoreline and create offshore habitats to improve fish and wildlife populations. Habitat restoration projects have been implemented at the following sites:

1. The Cootes Paradise marsh restoration project has several components. The most ambitious and uncertain intervention has been the construction of a carp barrier and fishway. The purpose of the carp barrier is to reduce the impact of carp on aquatic vegetation caused by their continual foraging behaviour among the plants. The fishway allows the movement of other species into and out of the marsh. The majority of carp were excluded from the marsh in 1997, the first operating year. As a result, there was substantial improvement in water clarity and immediate growth of submerged vegetation throughout the marsh. There was 50% cover by 5 plant species in the west end of the marsh. This was the first reported occurrence of submerged plants in the open marsh in 40 years. Natural recovery of emergent vegetation is augmented with an ambitious replanting program. Plants are grown in a coconut fibre mat at the Royal Botanical Garden's (RBG) plant nursery and staked out in the marsh. Successful planting restored 13 ha of marsh in Hopkins Bay. Amphibian nursery habitat was constructed in 1996 to rehabilitate amphibian populations. Results from 1997 indicate increased numbers and species of amphibians using the newly constructed habitats. Public access was improved with the construction of the Desjardins Trail, and Chedoke Creek trial project completed in 1996 by the City of Hamilton.

2. The Grindstone Creek project includes: constructing a low level dam to maintain minimum water levels; creation of emergent marsh; carp exclusion; construction of shallow channels into the flood plain; and construction of a marsh boardwalk to protect the marsh. Submerged aquatic vegetation in the spawning marsh has increased from 10% cover in 1994 to 90% cover in 1996 and 1997. The number of spawning pike has increased from 19 in 1986 to more than 240 in 1996 with many uncounted fish spawning on the restored marsh floodplain.

3. The LaSalle park project components include: construction of a western promontory and underwater reef, a restored beach, underwater reefs and emergent shoals and construction of a complex shoreline which has doubled the riparian edge. In 1996 large numbers of young largemouth bass were using the new habitats and the total number of fish species has increased.

4. The Bayfront Park project includes shoreline enhancement and construction of artificial reefs. Sixty-five underwater structures were installed to create an artificial reef. The reef is being used by native fish species at about four times the density of other adjacent habitats. This project is unfortunately attracting fish to an area frequently affected by an upwelling of anoxia and will not be successful until oxygen is restored to the hypolimnion.

5. The Northeast shoreline project includes the construction of three islands, submerged reefs and a sheltered shoreline creating an area of lagoon habitat to encourage the growth of aquatic plants for fish and waterfowl. Rock reefs and shoals create habitat for fish and migratory wading birds. The project also provides a windsurfer launch, a trail and a viewing platform to bring people back to the Bay. More than 900 pairs of colonial nesting birds nested on the new islands in 1997. The aquatic plant community between the islands and shoreline changed from unvegetated to approximately 50% cover of submerged vegetation. The fish community responded and species richness increased from 6 to 16 fish species.

Extensive assessments of both Hamilton Harbour and Cootes Paradise have been undertaken since the late 1980s, using standardized electrofishing and macrophyte surveys. The results have been used to track changes in aquatic vegetation cover and fish community composition. These data and comparable results from other Areas of Concern have been used for the development of a range of predictive models linking fish and habitat.

Other DFO Regions

In the other DFO regions, salmonids garner most of the attention of habitat science in freshwater. However overall, freshwater habitat science has not been a large component of DFO research effort and recent down-sizing has had negative effects. In the three eastern regions, Newfoundland and Labrador, Maritimes, and Laurentian, Atlantic salmon has traditionally received most attention. Other freshwater species concerns have largely fallen to the provincial agencies.

Newfoundland and Labrador - Current freshwater research is concentrated on effects of flow changes in rivers and streams resulting primarily from dam construction. Some studies the impact on fry and parr of instream habitat enhancements has been undertaken. There is a long tradition of population studies of Atlantic salmon and Arctic charr in the region. Lacustrine rearing on salmon and charr has received greater attention in this region. For a number of years, various fertilization and biomanipulation experiments and studies were conducted at the Experimental Ponds Area in central Newfoundland. There was also an Experimental Rivers program. Other salmonids like brook trout are gaining more attention from anglers and researchers as Atlantic salmon have become less abundant. Projects involving whole lake and river destruction are drawing more attention at present, projects like Voisey's Bay nickel mine and hydroelectric development on the Lower Churchill River. Research and Habitat Management groups have been working more closely in recent years.

Maritimes - Researchers in this region made major contributions to the study of the freshwater impacts of acidic deposition on Atlantic salmon. Many of those scientists have now retired or have redirected into more marine-oriented studies. A major long-term study of Atlantic salmon in Catamaran Brook has recently been transferred to university control along with the scientist leading the work. The region's primary focus is marine and freshwater habitat research has declined in importance.

Laurentian - Few resources have been directed into freshwater research in the region. Some studies were supported during the LRTAP and HAP programs and some habitat research on Atlantic salmon in rivers was undertaken.

Pacific & Yukon - Pacific salmonids are the primary focus of freshwater science with other freshwater species largely being studied by the province albeit with smaller resources. Long-term studies like that on habitat manipulation due to forestry practices on Carnation Creek have largely disappeared now. There is considerable habitat manipulation and restoration activity directed to Pacific salmon in British Columbia under the Salmon Enhancement Program but relatively little research effort involved.

As the climate, physiography and landscapes are very different in these regions compared to the Prairies, few of the research results are likely to be directly transferable. However, conceptual and methodological advances should be useful everywhere.

The research efforts of other levels of government and the universities should not be forgotten when considering habitat science although, despite down-sizing and budget cuts, the federal research activity probably still accounts for the large portion of effort in staff and budgets.

Recently, the three main growth areas in C&A habitat science have been larger scale experimental studies, evaluation of habitat restoration and enhancement techniques, and the development of standardized assessment tools.

FUTURE FRESHWATER HABITAT SCIENCE

Considering the evident trends and the results of recent workshops and conferences focused on habitat science, nine (at least) non-exclusive areas of research activity are apparent:

1. Experimentation
2. Pattern Recognition
3. Productivity of Ecosystems and Fishes
4. Population and Community Dynamics
5. Time Series Assessment and Monitoring
6. Tools for Fish Habitat Management
7. Methodology
8. Inventory, and
9. Area Fish Habitat Management Plans.

Individual projects may address several items on this list. The items 1-4 are areas where research traditionally positions itself while items 6-9 are areas where management traditionally positions itself. In both cases, these responsibilities are only taken up if available resources allow. Item 5 tends to fall into the gap between research and management.

If one looks at fisheries management, it is relatively easy to recognize that some level of activity is occurring in the nine areas identified. The full range of habitat management responsibilities has yet to be acknowledged. The range includes small private docks, sea lamprey control as it affects other fish and habitat, navigation maintenance, cumulative development on lake shorelines, water diversion on large rivers, eutrophication, fish and substrate contamination, regional impacts of climate change, UV, and LRTAP, and invasions and introductions of species that re-engineer the ecosystem. Eventually, habitat and fishery management areas will be recognized as fully overlapping responsibilities. Indeed, there are some signs that habitat management (MPAs, aquatic reserves, etc.) may become an important means of managing fisheries. If fish habitat management is to attain a status on a par with fisheries management as is clearly necessary as part of sustainable ecosystem management, ways must be found to tackle all these nine areas:

*1. **Experimentation***: This covers whole system or large-scale habitat manipulation experiments, experimental evaluation of mitigation or compensation techniques, opportunistic studies of compensation and restoration activities, etc. Empirical observations from such experiments can lead to improved management. Such studies have been undertaken at ELA albeit with inadequate funding and recently additional experimental studies have been initiated in Ontario in inland lakes and in abandoned quarry and gravel pits. Whole system experimentation requires a lengthy commitment and fairly substantial investments in data collection. The more the ecosystem experiment efforts are coordinated and networked the greater the cumulative benefits of the investments. Studies of compensation and restoration techniques are a prime area opportunity, needing coordinated planning of standardized protocols. Standardized assessments can be written into compensation agreements and accumulation of the results across several projects with adequate controls can yield useful results.

*2. **Pattern Recognition***: This covers the exploratory examination of patterns in fish-habitat associations across areas and systems designed to discern linkage hypotheses. As with experimentation the main emphasis is on empirical observation and coupled with statistical modelling. It includes for example work to look at habitat links to biomass and production by species and community in small lakes, the work on fish habitat associations in large rivers, and the work done on productive capacity in littoral areas of the lower Great Lakes. Many aspects of our freshwater ecosystems and fishes are still poorly known. For example, basic information about species distributions and the factors determining those patterns is still patchy and incomplete. This type of work has produced many useful results and aids the longer-term need for documentation of resource properties over the vast areas of freshwater habitat in Canada.

*3. **Productivity of Ecosystems and Fish***: This covers many elements of long-standing research in all regions of DFO and elsewhere devoted to measurement and prediction of productivity at various trophic levels in freshwater ecosystems whether in the Great Lakes, in inland lakes (ELA, Turkey Lakes, and other lake clusters across the country) or in rivers (various salmon rivers on the East and West Coasts). Conventionally experimental and pattern recognition studies rely on static metrics. Central & Arctic scientists have played an important role internationally showing how rate process and production metrics can yield far greater insights. Interlinking empirical/statistical models of productivity across trophic levels continues to be a

challenge. We have yet to fully embrace this area as a full working component of habitat science.

*4. **Population and Community Dynamics***: This overlaps a lot with the previous item but has probably received less explicit attention in relation to habitat. Rather than emphasizing empirical observation and statistical modelling, functional and mechanistic modelling is the focus. Thus complementing the approaches in the three previous items. DFO and OMNR have devoted considerable resources to population modelling in relation to exploitation but only recently has the role of habitat supply begun to be addressed. In the USA, the EPRI-funded COMPMECH project examined many of the underlying theoretical issues related to the operation of density-dependent mechanisms, seeding a lot of the effort on individual-based models (IBMs). Currently the Great Lakes Fishery Commission is supporting a project examining the links between habitat supply and population dynamics in key stocks. Progress in this area is needed if we are to develop ways of determining how much habitat of a certain type in particular locations is needed to sustain natural fish productivity at desired levels.

*5. **Time-Series Assessment and Monitoring***: In the past C&A has devoted considerable resources to time-series information gathering, more often focused limnologically. Bay of Quinte, Bioindex, ELA, and LRTAP Biomonitoring fit this mode. Much of this effort has been curtailed as a result of downsizing and program cuts. The need for this type of anchor information is widely recognized but generally under-resourced. As year to year changes in some elements of habitat, e.g., water levels in lakes and flow rates in rivers in certain seasons, are closely linked to variable recruitment success in fish, we can expect that the need for monitoring will not decline. The scope may well broaden as habitat science expands. The continuing tension for groups like C&A Science is in finding the balance between accumulating monitoring responsibilities and the need to retain flexibility to address new issues or new aspects of old issues.

*6. **Tools for Fish Habitat Management***: We have invested a lot of effort in the development of different kinds of guidebooks proponents of development and HADD and NNL assessment procedures for use by those regulating development that affects fish habitat. It requires that researchers work more closely with the habitat managers and that both learn to blend research and management timetables and agendas. Efforts in this area provide an important source of ideas for research priorities. Work in this area has also allowed research to make better use of the results obtained in other aspects of the science. The emphasis needs to be on development of quantitative assessment tools, backed by appropriate validation and tests since the central issues in application of the HADD rule and the NNL principle are ones of significance and impact.

*7. **Methodology***: The focus here is on survey and assessment sampling procedures and data analyses for habitat managers and project proponents to follow when preparing project submissions and when fulfilling mitigation and compensation requirements. Methodologies evolved for research purposes often involve intensive data collection by highly trained personnel, and are difficult to transfer to operational contexts with unskilled staff. Beside, day to day habitat management should not require that every referral be treated as a research program.

Much of the information gathered and presented by project proponents as a basis for HADD and NNL determinations is of little or no use. Piecemeal assessments of fish stocks using limited gear and effort probably wastes a lot of money and contributes little to rational decision-making. More progress could be made if realistic, standardized sampling protocols were developed and mandated by habitat management agencies. Efforts to gather useful evidence of the efficacy of compensation and mitigation measures would be enhanced if standard sampling programs were prescribed by the regulators.

For example in Ontario, considerable effort has gone into the development by OMNR staff of a standardized detailed stream assessment protocol for site-specific cases supported by data management and training. This has resulted in the assembly of an extensive database covering a wide range of streams across Ontario. Collectively the data can be used to develop new assessment indices and test hypotheses about the factors affecting fish abundance and composition. Whether proponents will be willing to collect such information for all projects is untested. Simplified versions are being developed for use in watershed planning exercises and for use in regional inventory programs.

*8. **Inventory**:* Programs to inventory aquatic resources were popular in the 1960s and 1970s but fell out of favour later, in part, as resources become more limited. The other difficulty with inventories in the past has been the lack of purpose. Inventories should only be collected with explicit applications in mind. Effective management of any natural resource on the larger scales dictated by the scale and scope of human activities may not be possible if little is known about the resources being affected. Specific large-scale issues can generate enormous investments in resource inventory but often the mechanisms for capturing the information for other, future uses are poorly developed and resourced. For example, the LRTAP program led to large scale inventories of acid sensitive lakes in Eastern Canada to determine the scope of impact. Increasingly, advocates of environmental protection measures are finding that evidence of cause-effect has to be accompanied with cost/benefit information. For example with acidic deposition, it was not enough to know that acidification caused a loss of species richness in lake. It was also necessary to show how many lakes and how many species-populations were affected overall. Little of the extensive data generated by the LRTAP program was effectively incorporated into agency information systems. In related sectors like agriculture and forestry, inventory plays a major role and modern tools like remote sensing and GIS have been extensively used to augment on-the-ground capabilities. In the freshwater fisheries sector, there is growing evidence that recreational exploitation will need to be managed on a regional scale given the mobility and flexibility of anglers exhibited when faced with localized closures and restrictions. Further, human activities operate on regional and larger scales, be it suburban sprawl, forestry and agriculture, recreation, or mining and power developments.

*9. **Area Fish Habitat Management Plans***: This area is the least developed aspect of habitat science and presents many challenges given the spatial and temporal scales involved. Such planning was a major component in the 1986 Policy document but little has been done to meet the requirements identified. If natural fish productivity and self-sustaining fisheries are to persist in many freshwater areas, linked fishery and habitat management planning will be essential. Harvests are constrained both by exploitation and other human development pressures.

Currently fishery objectives are often developed in a vacuum rather than in an ecosystem context. Work on this area has been done by DFO in Ontario, in places like Hamilton Harbour, Severn Sound, Lake Erie in support of restoration planning and assessment. The eventual goal should be to create turnkey methodologies for establishing area management plans tuned to local and regional fish and fishery objectives. This area will provide the basis for designing aquatic protection areas (APAs). Development and support for information infrastructure, particularly GIS, will be critical for success in this area.

When considering the scope of the areas of research activity just identified, it is important to remember that DFO is not the only agency involved in the business of doing research and managing habitat. No one group can possibly address all the issues confronting us in the conservation and protection of freshwater fisheries and their habitats. Many agencies have a share of habitat management, including provinces and municipalities. Many groups are contributing research to the pool of knowledge, including groups in other agencies and universities. All will assume some share of the responsibilities, often working cooperatively. All important bases will be covered if all these participants consciously coordinate their priorities and activities.

THE PARTNERSHIP OF RESEARCHERS AND HABITAT MANAGERS

Having presented a snapshot of habitat science in Central and Arctic and having outlined a generic list of areas where research has a role, it is important to consider the relationship between researchers and habitat managers. One way of looking at this relationship is to consider what researchers alone, what habitat managers alone, and what both together have done in the past, are doing now, and need to do in the future (Table 2). The relationship has been evolving as the focus and emphasis has been changing for each group. In the past, especially before the habitat policy arrived, there was not a strong focus on habitat per se. Research programs developed and staffed primarily as a result of water quality management problems (eutrophication, contaminants, toxic effluents, acid rain). As the policy implementation has grown, the habitat issues, many of which are physical rather than chemical, have been better defined. Implementation is beginning to mature with increased emphasis on building a stronger scientific base for decision-making and finding ways to produce consistent delivery across Canada. The Habitat Action Plan fostered an increased level of interaction between management and research. That partnership is now poised to grow, despite the decrease in resources experienced by most agencies and the shifting regulatory ground.

We are still far from the ideal of achieving No Net Loss of Productive Capacity locally or regionally in Canada, in Central and Arctic Region. The opportunities exist for managers and researchers to work together to ensure that fish habitat is conserved and protected as envisaged in the Habitat Policy and required by the Fisheries Act.

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Table 2. Assessment of the past, present, and future of activities within and between the habitat management and research arenas.

Time period	Management	Both	Research
Past	-Most decision-making was fuzzy and dependent on the expertise and experience of staff -Complained that Research never provided answers to important questions	-Habitat was not a priority as other factors like exploitation were seen to be more important -Overlap mainly on BIG projects that funded assessment and research activity -Little communication in either direction	-Relatively little activity was directed at the habitat issues most often encountered in management - Complained that Management never asked questions amenable to scientific answers -Research more directed to WQ issues
Present	-Habitat is a hotter issue now although environment as a whole is not -Need more answers on more fronts -Many existing mitigation and compensation actions are untested	-Increasing communication -Limited joint planning and execution of activities designed to improve decision-making -Budgets and staff in shorter supply -First steps towards joint priorities	-Experimental habitat studies have begun but take time and cannot possibly cover all the habitat manipulation issues arising
Future	-Allocate some time and resources to long-term activities -Greater emphasis on using quantitative assessment for HADD and NNL determinations -Invest more in area habitat management plans -Work toward consistent delivery regionally and nationally	-Meet and interact regularly on more than just immediate specific issues -Identify and support the agencies who will be the custodians of habitat management plans -Establish monitoring protocols for mitigation and compensation techniques whereby cumulative assessments of effectiveness can be done -Greater need to capitalize on new opportunities where 3rd-party funding is available	-Closer attention to setting priorities based on the scale of impacts -Allocate some time and resources to short-term activities -More emphasis on translating results into management tools and guidelines -More investment in methods that can scale up from sites to systems

3.0 WORKSHOP TOPICS

3.1 APPLYING NO NET LOSS QUANTITATIVELY

3.1.1 BACKGROUND

The concepts of **harmful alteration, disruption and destruction (HADD)** in the *Fisheries Act* and **No Net Loss (NNL)** in the Habitat Policy are implicitly quantitative ideas. Hence decisions about HADDs and NNL should be based on scientific methods with gains and losses being expressed in numerical units. Effective and consistent implementation of HADD and NNL have been held back by the lack of quantitative tools for assessing changes to fish habitat. Recently a quantitative framework has been published (Minns 1997), allowing changes to be assessed via net change equations. The equations lead to explicit global limits on development given that natural fish productivity objectives are to be sustained.

For natural resource management to succeed in the long-term, the present regimen of arbitrary, pragmatic decision-making dependent on the accumulated experience and expertise of a limited number of habitat biologists must be replaced by an objective, science-based reproducible decision-making systems. Scientifically-defensible methods of assessment are needed. Such methods can be applied consistently in all parts of the country without reliance on the practitioners having specialized knowledge and expertise.

"Straw Man" Objectives:

1. Science-based decision-making about projects that affect fish habitat.
2. Adoption by all jurisdictions of "no net loss" as a quantitative requirement.

3.1.2 LIST OF OBJECTIVES

After a discussion session, the breakout group drafted **five major objectives** to address the need for regional consensus on the effective and consistent implementation of the 'no net loss' (NNL) concept:

1. **Decision-making about projects that affect fish habitat should be science-based, the information from which should be quantitative and defensible.**
2. **Adoption by all jurisdictions of 'no net loss' as a quantitative requirement.**
3. **Develop consistent approach to dealing with temporal issues.**
4. **Take a conservative approach to deal with uncertainty.**
5. **Develop practical, useable approaches to assessing NNL.**

A major discussion centered on distinguishing between two types of science that are at play in habitat assessment procedures. The first type, referred to as "**big 'S' science**" in this session, involves the scientific method. It provides the advantage of rendering an issue into quantitative

values that everyone can agree on. The second type, " **small 's' science**" is based on experiential knowledge of the individual biologist. This latter type of science is often employed in our assessments or approach to certain projects. In Ontario, for example, tons of boulders have been dumped into streams to create habitat or compensate for habitat lost. Such practices often provoke questions such as: Is this a good procedure? Is this action science-based? Has the consequence of such action been documented qualitatively or quantitatively?

Dr. Minns emphasized that "big 'S' science" should be a protocol allowing one to render the analysis in a quantative fashion. The use of "small 's' science" i.e. knowledge or opinion of the individual runs the risk of ending up with a number of interpretations. Therefore, the term "science-based" connotes "quantitative" in his professional viewpoint. The group agreed on modifying the first objective to stipulate that "science-based" infers "quantitative and defensible".

The use of the word 'science' may generate aversion in some people because it creates a perception of a stringent research program that involves time and resources, which may be judged inappropriate for a proposed project. One opinion indicated that the idea of applying a science-based model to aspects of some projects may not be a necessity when the use of knowledge with a consideration of one or several established ecological principles are combined. The resulting impression is that decisions have been 'science-based and combined with information available' after an assessment has been made. This is perhaps the most commonly accepted perception in our deliberations with proponents and is viewed as adequate for now until scientific research provides better tools.

Other topics discussed included:

- The need to deal or acknowledge temporal issues related to NNL - some project impacts are short term because recovery of the disturbed habitat is rapid; in contrast other projects have long term or permanent impacts.
- How do we deal with instances where "traditional ecological knowledge" is available? Is it an objective or an information/consultation procedure to address an objective.
- Are existing methods of making decisions regarding NNL practical?
- Saskatchewan, Manitoba and Ontario adopt NNL as a principle in the course of their assessment work. Alberta also adopts it; in reality however, there is inconsistency as to who it applies to.

3.1.3 BARRIERS, GAPS AND OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes):

1. **Need to assess and measure the various compensation procedures currently in use. Is there consistency in our knowledge of each procedure's effectiveness? (17)**
2. **Lack of information exchange across jurisdictions - a current problem is inconsistent data management standards across jurisdictions. (14)**

3. **Lack of consistency in use of information. Post project development and data collections often never undergo evaluation. (14)**
4. **What information is required and how is it to be used? We need to communicate those needs adequately to developers and not prescribe endless lists of monitoring requirements that we do nothing with. (11)**
5. **Staffing/funding constraints. (10)**

The discussions leading to the formulation of the above list are summarized as follows:

Barriers:

- Staffing/funding. Comments were made that this issue should be the onus of the proponent. However, the context for government was that this is an issue of how priorities are set and how allocation of government moneys are made with regard to scientific knowledge required to improve habitat management decision.

- What information is required or needs to be collected? Do we know what we need and are we communicating those needs adequately to developers? This problem may reflect a lack of management plans or not addressing objectives for watershed/landscape level planning. Dr. Minns emphasized that it is important to accommodate knowing what information is required with also knowing how the information will be used. There must be an endpoint in mind. Too often we ask for data that may be unnecessary for our decision making and this serves only to delay the process. There may also be occasions when we prescribe endless list of monitoring requirements that we do nothing with.

- Regulatory systems not suited to NNL applications.

- Lack of consistency on how we use the information. Post project development data collections may never undergo evaluation.

- Compensation. Knowing what compensation measures do or do not work well. Is there consistency in our knowledge of the effectiveness of compensation measures? How do we assess what works? It seems that evaluation of such compensation measures are required.

- Political directions not suited to NNL applications. This is the underlying reason for the preceding item. Alberta and Ontario have both recently modified their procedural policies in the processing and assessment of proposed projects.

Opportunities:

- Enter into a partnership with proponents for data collection. Should we appeal, for example, to a proponent's "good corporate citizen" image to obtain commitment towards the collection of high quality data?

- Information exchange. There is a need for a compilation of "centralized" or "3rd party" databases. A current problem is inconsistent data management standards across

jurisdictions.

3.1.4 ACTIONS

The **top five actions** chosen by this group were as follows

APPLYING NO NET LOSS QUANTITATIVELY

Rating	Action	No. of Votes
1	**Integrate science and habitat management policy/priorities.**	12
2	**Develop standardized format for gathering, reporting and using fish habitat information.**	12
3	**Use new compensation agreements effectively (e.g. establish consistent monitoring programs).**	12
4	**Develop protocol for information needs that are linked to a required assessment or monitoring program. More important, apply this model and actively evaluate its effectiveness.**	11
5	**Assess previous projects and learn from these past experiences.**	11

Other action items that earned a smaller number votes were also documented to show the other actions that were considered (Numbers in parenthesis represent the number of votes):

- Adopt tools for centralized, accessible databases. (8)
- Educate senior management and industry. (7)
- Improve communication. (6)
- Protocol for standardized analysis. (3)
- Identify knowledge gaps (agency role). (3)
- Aquatic classification systems. (2)
- Priorize activities. (2)
- Data Rescue. (1)
- Partnerships. (1)

In the discussion leading to the formulation of the top five actions, this group methodically listed possible actions that should be undertaken to address the five major barriers/gaps/opportunities.

1. Assessing what works:
   - Run annual workshop - both broad-based as well as focused/issue-oriented.
   - Assign more/better monitoring by proponents.
   - Assess past projects and learn from these past experiences.
   - Integration of science and habitat management policy/priorities.
   - Use new compensation agreements effectively, e.g. establish consistent monitoring

programs.

- Actively seek partnerships with proponents to address issues, e.g. effectiveness of compensation/mitigation.
- Take a rational, staged or step-wise approach; recognize that we cannot get everything done in one project induced effort.

2. Lack of fish/fish habitat information:
   - Identify knowledge gaps (agency role).
   - Need aquatic classification scheme applied on a regional basis (eco-regional recognizance).
   - Need standardized format for gathering (methods, protocols), reporting and utilizing fish habitat information.
   - Adopt common tools for centralized, accessible databases.

3. Lack of consistency in how we use the information:
   - Develop protocol identifying standardized analysis linked to monitoring/assessment endpoints (e.g. collect only information linked to a required assessment or monitoring program).
   - Model development and getting it out and adopted as a useable tool.
   - Link to decision-support mechanism (i.e. part of a feedback loop).

4. Staff and money:
   - Develop partnerships with industry/cross-agency.
   - Seek innovative means of finding money beyond traditional government funding mechanisms.
   - Priorize activities - respective of the defined type of business you are in (i.e. inventory vs. auditing, etc.).
   - Educate industry and senior management (e.g. Ecological Sustainability Leadership training that is occurring in Ontario).
   - Communication of problems.
   - Training practitioners.

3.1.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

APPLYING NO NET LOSS QUANTITATIVELY

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	90	10	0
Are the gaps important?	80	17	3
Do the actions have value?	80	20	0

FACILITATOR: Karen Broughton

RECORDER: Steve McGovern

3.2 WHOLE LAKE DESTRUCTION

3.2.1 BACKGROUND

The issue of whole lake destruction most often arises when new mines are being proposed (e.g. uranium, diamond, gold mines). Proponents cite the need to utilize lakes as tailings or waste rock disposal areas or to drain lakes to mine the underlying ore bodies. Regulators must determine whether or not the loss of a particular lake is acceptable, and whether compensatory measures are available to achieve No Net Loss (NNL) of the productive capacity of fish habitat resulting from the destruction of that waterbody.

Experience to date has shown that it is difficult to apply No Net Loss effectively when whole lakes are destroyed. Factors such as the quantification of habitat loss, the adequacy of the proposed compensatory measures, particularly when a *like for like* proposal is not feasible, the lack of perturbed fish habitats near the site which could be rehabilitated, the perceived need to create compensatory habitat within the First Nations area impacted by project, and the quantification of habitat gains must all be considered in determining whether NNL can be achieved.

"Straw Man" Objectives:

1. Avoid loss of, or damage to, fish habitat that could result from whole lake destruction.
2. Shared assessment methods and protocols that all jurisdictions can use to assess whole lake destruction proposals.

3.2.2 LIST OF OBJECTIVES

The breakout group provided the following list of four objectives:

1. **Ensure NNL is achieved on a project by project basis.**
2. **Use science to quantify losses and gains.**
3. **Have a consistent methodology and process/policy when dealing with whole lake destruction.**
4. **Ensure that a temporal loss of habitat is included in the NNL calculation ("temporal loss' is defined in the discussion notes below).**

The discussion leading to the formulation of the objectives covered numerous topics and observations. These included:

- HADD is unavoidable with whole lake destruction.
- Is whole lake destruction the only option?
- Governments will only allow whole lake destruction if the lake is insignificant.
- Need to use money for compensation in a significant way, not create another insignificant

lake.

- Politics may enter into the decision.
- Our actions now are precedent setting.
- Are lakes insignificant now only because they are numerous?
- Compensation should always be in the form of increasing fish productivity.
- If the lake is critical then project should not go ahead.
- The methodology of ensuring NNL in small projects should be consistent with the methodology used in whole lake destruction.
- Establishing if lakes do have intrinsic value would appear to be based on the judgement of individual assessor(s) ["judgement calls"]. If like for like compensation is not applied then cumulative effects will occur in the area.
- Draining reservoirs will cause a temporary fish habitat loss for 3-4 years and any compensatory measures make several years for replacement habitat to attain the projected full productivity. For such instances, we should ensure that this temporal loss is included in the NNL calculation.
- Is a contingency plan required if compensation doesn't work? This type of situation would provoke a ***due diligence*** argument versus a ***perpetual jeopardy*** argument.
- Reconciliation of hierarchy of preferences for compensation in NNL Policy.
- Compensation has to fit in with area management plans.
- Management plans, however, often don't exist especially for pristine areas.

3.2.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes):

1. **Need for scientifically defensible method for estimating loss of productivity with respect to whole lake destruction. (18)**
2. **Need to have other options available if we cannot achieve NNL through standard compensation measures for a particular site. (17)**
   - If, for example, it is not feasible to create replacement lake/stream habitat, then the acceptability of trust funds or funding for research initiatives may be pursued.
3. **How does whole lake destruction fit in DFO'S NNL policy? (15)**
   - Should we be even authorizing whole lake destruction at the biologist level?
   - Should there be an additional entry to the hierarchy of preferences?
4. **How do we achieve NNL with the destruction of a whole lake in relatively undisturbed or pristine areas? (15)**
   - The needs of First Nations groups may, for example, influence decision making.
5. **Need to evaluate past and future whole lake destruction/compensation agreements as well as results of monitoring/surveillance projects. (11).**
   - This collective database and knowledge are essential for making informed decisions during assessments of future projects.

Additional gaps/issues that were also proposed included:

- Need consistent approach to making decisions on whether to allow whole lake destruction to proceed.
- Lack of fish community objectives.
- Involvement of stakeholders (e.g. First Nations).
- Our lack of understanding of ecosystem function.

The discussion focusing on gaps/barriers/opportunities covered numerous observations and topics that were recorded as follows:

- There is no way of estimating loss of productivity of whole lakes.
- What are the ecosystem dynamics of a lake? Is the lack of understanding too great to overcome?
- Is whole lake destruction beyond the NNL policy and should it be excluded?
- Regulators don't know how or where to compensate since whole lake destruction often happens in pristine areas.
- The foremost issue in Saskatchewan is how to achieve NNL in a relatively undisturbed area.
- As regulators, we seek clarification of decision-making criteria for go/no go to proposal, i.e., should authorization be issued?
- If you can't compensate then you shouldn't authorize.
- Mining industry thinks we are inconsistent. They perceive that some projects get caught up in a go/no go decision process step while others end up in a compensation process.
- Lack of fish management plans and objectives complicates decision making. What fish communities, for example, do regulators want to enhance? Regulators also need some guidance in deciding if they want to introduce a warm water fishery or a cool water one.
- Are fish management plans beyond the scope of this workshop?
- Fish management plans are not clear in northern undisturbed areas.
- An issue in Newfoundland is how to quantify loss, compensate and get a gain of fish productivity.
- Need science to quantify what is valuable.
- Aboriginal use of area must be taken into account in our evaluations and decisions.
- First Nations People insist that compensation actions must stay in the area and not be located at distant sites.
- How do you involve stakeholders (usually First Nations) who want compensation in their backyard.
- Is hierarchy of preferences in NNL policy adequate for whole lake destruction?
- The Policy is not the problem because it is flexible. The problem is more in dealing with local stake holders who want the benefits in their area.
- Need a catalog of compensation measures that have been tried and an assessment of how well compensation worked. This information should also be disseminated in an appropriate report.
- Need centralized database.

- We may have three or four examples of whole lake destruction in Canada.
- These issues also apply to destruction of whole river systems e.g., oil sands and coal mine developments; reservoirs for hydroelectric developments.
- Can research be considered compensation? For example, conduct scientific experiment(s) where we create recreate streams and lakes and then commit to a long term monitoring (e.g. 10 years) of these man made situations. Questions that can be addressed may include: What structures work for which species? What revegetation procedure works best?
- This type of information is lacking, especially in the north.
- What are our options to keep compensation in undisturbed areas?
- Need to find creative solutions for compensation.
- There must be a recognition by all parties involved that we may be on the edge of technology and understanding; consequently, we need to tell proponent that proposed measures are experimental and that valuable lessons can be gained from the outcome.
- Achievement of NNL might actually not happen if the proponent embarks on one or more new compensation methods that have yet to be proven successful.
- NNL is a principle not a statutory law.
- Recognize process of learning, use adaptive management.
- Proponent cannot be perpetually responsible for the risk that we managers take.
- Sometimes NNL cannot be achieved so we need to formalize what we need to do as managers as a trade off for both large and small projects.
- Proponents want to proceed with their project and may want to be told up front what will be required to address fish habitat concerns or impacts.
- Need to be able to rationalize moving compensation to another site, because we will be decreasing number of lakes in the area's ecosystem.
- Federal policies need to be parallel with the provincial policies in regards to whole lake destruction and compensation.
- Habitat management trust fund: An example was cited where a trust fund was set up with a local advisory board. The money will be used to create habitat at some time, but there will be a time lag.
- Is habitat banking plausible?
- Regulators don't want cash for habitat.
- There must be clear link from cash to habitat.
- Make the company accountable for delivering habitat.
- Cash compensation is a bad idea and its use can be easily viewed as setting a precedent. A bad result is that in the end we may end up with a loss of habitat and instead have a pile of money on our hands.
- It will be extremely difficult to find a place to spend the money up north.
- Does the *Fisheries Act* even apply if a fishery does not exist?

3.2.4 ACTIONS

The **top five actions** proposed by this group were as follows:

WHOLE LAKE DESTRUCTION

Rating	Action	No. of Votes
1	**Conduct a review of past projects and compensation measures used with the objective of gaining useful, collective knowledge from case history successes and failures.**	16
2	**Conduct specific research projects on estimating productivity with respect to loss of lake or creation of lake.**	15
3	**Develop an explicit decision framework for determining if the loss of a lake is acceptable and NNL is achieved. If the latter is not achieved through current compensation technology, then will other measures, such as *trust funds* or *funds for research*, be acceptable?**	15
4	**Conduct research on the feasibility of various compensation measures in adjacent undisturbed environments (e.g. creation of spawning marshes; spawning shoals).**	14
5	**Develop protocols that describe information requirements to assess productivity.**	13

Three other action items were also considered

- Need to know the value of a lake which will be lost in regional context.
- Development of area Fishery Management Plans.
- Policy review at some point to account for other options in hierarchy of preferences.

The discussion leading to the formulation of the action items covered many topics:

- Need a science program that is devoted to using the information that is already available.
- Need management to decide how to measure compensation in a consistent way and arrive at measuring productivity consistently.
- Good role for DFO to enter into a partnership with mining associations, e.g., match money with private companies for developing protocols.
- Need to reconcile all provincial and territorial regulations as well; therefore, there will be a need for federal involvement.
- Policy review would lead to numerous and possible needless complications.
- Policy review should be based on revised protocols, not to accommodate a certain project.
- Could review just hierarchy of preferences not whole policy.

- Directed review of past projects must be done to gather information on what procedures succeeded or failed.
- Need research to know what you can do to enhance undisturbed fish habitat.
- Need to reconcile regional and provincial policies.
- Need for research into feasibility of various compensation options in pristine environments.
- Need more effort into area management plans and fish community plans for undisturbed areas.
- Is it feasible to set limits on development for undisturbed areas?
- Cumulative effects of destruction of lake should be considered. An important aspect is to consider if the lake is unique in the region or is it a representative lake.
- Need regional context setting so can evaluate cumulative effects and impacts?
- Need to know value of lake in area - this would be more of a planning exercise than a research project and should be the responsibility of the proponent.
- Will ground water loss occur in other lakes because of lake destruction?
- Information needs for CEAA must be anticipated, i.e. cumulative effects.
- Need step wise process to go through in a consistent manner to determine if a HADD will occur, and determine compensation and whether to authorize.
- NNL is not always going to be the endpoint, however in the policy it clearly states that for each project NNL will occur.

3.2.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

WHOLE LAKE DESTRUCTION

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	68	32	0
Are the gaps important?	63	33	3
Do the actions have value?	71	18	11

FACILITATOR: Kathy Fisher

RECORDER: Beth Thomson

3.3 CUMULATIVE EFFECTS

3.3.1 BACKGROUND

Each project, large or small, adds to the accumulation of habitat changes exerted in both local and regional contexts. If prescribed fish community and fishery objectives are to be sustained in the long-term, ultimate limits on development will have to be set. In many settings across Canada, the landscape and watersheds have already been greatly altered, changing the composition and productivity of the fisheries. Proponents of individual development projects cannot be held accountable for all the past insults applied to the habitats in the vicinity of their development and, probably, are unwilling to be held accountable for future effects arising from cumulative impacts to which they are contributing. Society does not, as yet, fully subscribe to the idea of setting limits to development.

In Canada, various jurisdictions have established legislation with "trip wires" which, on crossing, require that the cumulative impacts of specific developments be assessed. At present, this legislation does not set development limits for specific areas and most of the cumulative assessments amount to little more than check-list evaluations of other legislation. Thus, when the *Fisheries Act* is the trigger, CEAA is invoked and various departments examine the implications with reference to their own legislative responsibilities. In practice, this exercise rarely leads to the development being stopped or significantly altered. It is also unlikely that the kinds of information and analyses necessary to assess cumulative change were available. Most cumulative impact assessment is at present superficial and inconsequential, lacking quantitative, scientific rigor.

"Straw Man" Objectives:

1. Avoid loss of, or damage to, fish habitat that could result from the cumulative effects of several projects affecting the same watershed.
2. Shared guidelines that clarify when cumulative effects assessment is a requirement for decision making.
3. Shared cumulative effects assessment methods and protocols related to fish habitat.

3.3.2 LIST OF OBJECTIVES

The breakout group formulated a list of six objectives after a period of discussion:

1. **Avoid cumulative loss.**
2. **Shared decision guidelines that clarify when cumulative effects assessment is a requirement for decision making.**
3. **Shared cumulative effects assessment methods and protocols.**
4. **Agreed definition: *slow net loss* should be a term to describe the tiny contributions by individual projects that incrementally add up a cumulative loss.**
5. **Provide a definition of biodiversity and productive capacity.**

6. **Watersheds are appropriate boundaries.**

3.3.3 BARRIERS AND OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes):

1. **Need watershed-based database. (11)**
2. **Research required on micro, macro, and synergistic actions. (10)**
3. **Quantitative measurement guideline to describe what should be measured and the methodology to follow. (9)**
4. **Public education and involvement efforts needed to educate the general populace. (8)**
5. **Cost (5); clarify responsibilities (5); management plans (5).**

The list was derived from the discussion focusing on gaps/barriers/opportunities which covered a series of topics and observations which are summarized as follows:

- There is a need for watershed-based fish habitat impact database. We need to collect some kind of historical database documenting the decisions, results and consequences of previous habitat impact events. Some measurement of the aforementioned "slow net loss" or cumulative changes that can occur within a specific watershed would provide baseline reference for habitat managers. We also need to resolve who would own the database.

- Need to have research with particular emphasis on how micro changes affect macro changes in watersheds. With the possibility of synergistic effects occurring with two or more individual events (chemicals or effluents entering a watershed.), is it possible to qualify and quantify the overall impact?

- Quantitative measurements must be done. There is a need for some kind of standardized guideline describing what needs to be measured and the acceptable methodology required. This data would be incorporated into a guideline for impact assessment that considers cumulative effects.

- There should be a guideline for "acceptable" change and there must be inter-jurisdictional agreement on thresholds.

- Definition of Valued Ecosystem Components (VEC). Who/ How?

- What are the costs of assessing cumulative impacts?

- Public education and involvement: The public that live in the watershed, i.e., the stakeholders, need to acquire an understanding of cumulative effects. Communication is therefore important because an informed public will want to have input in the evolution of

a proposed project and to play an important role in helping the habitat managers make decisions on acceptable or unacceptable losses.

- Rationalize regulatory monitoring responsibilities. An important aspect is to disseminate information among all agencies in a rapid and accessible manner (e.g., internet; intranet).

- Clarify resource management responsibilities. There may be a need for guidelines for watershed management and coordination.

- There must be political acceptability for decisions that take cumulative effects into account.

- There must be management plans to respond to cumulative effects geared to address whole watershed study and collection of pertinent data.

3.3.4 ACTIONS

The **top five actions** proposed by this group to address the list of barriers/gaps/opportunities were as follows: (number of votes were not recorded):

CUMULATIVE EFFECTS

Rating	Action	No. of Votes
1	**Task a group to define what needs to be measured.**	n.r.
2	**Make an inventory of existing information.**	n.r.
3	**Use new compensation agreements effectively.**	n.r.
4	**Establish shared standards and protocols for database.**	n.r.
5	**Develop a co-ordinated public education campaign.**	n.r.

n.r. = not recorded

The discussion leading to the formulation of the top five actions covered several topics and observations as follows:

- Assign database building to someone; e.g., a specific position in a specific agency.
- Establish standards and protocols for database.
- Workshop should be conducted among all data suppliers and users to develop shared standards and responsibilities.
- Establish research priorities.
- Do an inventory of existing information.
- Identify the need for a cumulative effects workshop on fish habitat.
- Educate managers and politicians about this need.

- Identify focus areas for cumulative effects research.
- Build from experience, insights, and local knowledge
- Task a group to define what must be measured (consult with American Fisheries Society)
- Task a second group to make an inventory of methods for gathering the required information.
- Make an inventory of potential impacts on each watershed.
- Develop a coordinated public education campaign that will help them understand incremental (cumulative) effects.
- Get the public involved in watershed management plans.

3.3.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

CUMULATIVE EFFECTS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	72	28	0
Are the gaps important?	77	23	0
Do the actions have value?	67	33	0

FACILITATOR: Bill McMillan

RECORDER: Dorothy Majewski

3.4 REGIONAL SCALE PROJECTS

3.4.1 BACKGROUND

A number of large scale projects are currently taking place or are proposed for development within our region. These include uranium, coal and diamond mining, oilsands development, forest harvesting and water diversion and impoundment projects. All of these potentially involve alteration of fish habitat. Although the nature of these habitat impacts may differ, a common set of problems persists in how habitat managers might address these over the large spatial scale, or in a regional context.

On a regional scale, habitat impacts may result from cumulative effects of a number of similar developments (e.g. adjacent oil sands leases), or from a single large project that affects a broad area (e.g. surface mining). In some cases, two or more different projects may be occurring in the same area, and may have combined impacts that make regional assessment a requirement.

"Straw Man" Objectives:

1. Avoid loss of, or damage to, fish habitat that could result from the cumulative effects of several projects affecting the same watershed.
2. Shared guidelines that clarify when cumulative effects assessment is a requirement for decision making.
3. Shared cumulative effects assessment methods and protocols related to fish habitat.
4. A consistent and predictable approach that habitat managers can use to determine the scope of regional study requirements.

3.4.2 LIST OF OBJECTIVES

The group adopted the four straw man objectives. They also decided that objectives should be identical to the ones developed in the preceding concurrent plenary session on cumulative effects; therefore, two additional objectives are included to complete their list.

1. **Avoid loss of, or damage to, fish habitat that could result from the cumulative effects of several projects affecting the same watershed.**
2. **Shared guidelines that clarify when cumulative effects assessment is a requirement for decision making.**
3. **Shared cumulative effects assessment methods and protocols related to fish habitat.**
4. **A consistent and predictable approach that habitat managers can use to determine the scope of regional study requirements.**
5. **Biodiversity/productive capacity definition.**
6. **Watersheds are appropriate boundaries for the term "Region".**

3.4.3 BARRIERS, GAPS AND OPPORTUNITIES

The group produced a list of their **top five gaps**:

1. **Monitoring requirements of proponent**.
   It is not clear who should conduct a monitoring program of an approved project.
2. **Incremental additions to regional projects**.
   Positive criteria (e.g. favourable market conditions or discovery of larger ore reserves for a mining project) may lead to a proponent applying for modifications or expansion of an approved project.
3. **Lack of accountability of proponents for predicted effects**.
   Proponent may promote positive effects of aspects of a project that can improve fish habitat but there is no firm mechanism to assure that such benefits are realized. Follow-up monitoring or auditing is lacking.
4. **Need to include corridor projects as potential regional projects**.
   Highways and pipelines cross numerous tributaries in a watershed and each in effect can be cumulative in its impact on the watershed.
5. **Concern about incremental "piecemeal" approvals on projects that should be regional**.
   An example of this gap was cited, i.e., forestry management agreements. This type of agreement may divide a forest region into smaller sections, but in fact the ultimate plan will result in the effective deforestation of a whole watershed. What should be done is to treat the forestry plan as a single regional project. Similarly, many small irrigation projects in several headwater streams should in reality be treated as a regional scale project.

3.4.4 ACTIONS

The group had no time to develop a specific list of actions to address their list of barriers/gaps/opportunities; however the facilitator indicated that the group agreed that the actions identified in "Cumulative Effects" could also be applied to Regional Scale Projects. The group's discussion notes, however, indicated that their discussion covered three topics that would have constituted **three action items**:

1. **Impacts of regional scale projects on fish habitat must be monitored carefully.**
2. **This action should also be accompanied by efforts to determine the effectiveness of mitigation procedures that may have been stipulated.**
3. **Funding for the previous two actions, always a fundamental problem, could be addressed with creative compensation agreements.**

3.4.5 PLENARY REVIEW OF RECOMMENDATIONS

Workshop participants were asked to vote on the gaps presented at the plenary session. The results were as follows:

REGIONAL SCALE PROJECTS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	n.a.	n.a.	n.a.
Are the gaps important?	82	18	0
Do the actions have value?	n.a.	n.a.	n.a.

FACILITATOR: Bill McMillan

RECORDER: Neville Ward

3.5 TIMBER HARVESTING IMPACTS ON WATERSHEDS

3.5.1 BACKGROUND

An increasing amount of attention is being directed at the influence of large scale land clearing on surface waters and to a lesser extent subsurface flows. Generally it is acknowledged that timber harvesting is known to cause increased run-off rates, increased sediment, increased water temperatures, changes in nutrient transfer, changes in organic carbon, aquatic structure etc. It is also recognized that near surface groundwater plays a significant role in the determination of surface flows during periods of minimal precipitation and infiltration, i.e., drought, frozen substrate. Biological investigations have also identified the significance of groundwater discharge in support the incubation and overwintering of fish populations in northern temperate waters. Limited information is available from northern boreal and eastern foothills forests on the influence of large scale land clearing on surface and groundwater discharge. Land and fish resource managers are having to make general assumptions on the linkages that exist between forested lands and surface/groundwater discharge in making decisions on the size, location, timing and extent of clearing. Subsequent monitoring is almost non-existent.

"Straw Man" Objectives:

1. Timber management will not affect hydrology of surface and groundwater in a manner that harms, disrupts or destroys fish habitat.
2. A uniform and scientifically defensible approach to assessing the impact of timber harvesting on fish habitat.
3. A common acceptance that fish habitat is directly affected by large scale harvesting or removal of vegetation on adjacent lands.

3.5.2 LIST OF OBJECTIVES

The breakout group incorporated the straw man objectives in the creation of a **list of five objectives**:

1. **A common acceptance that fish habitat is directly affected by large scale harvesting or removal of vegetation on adjacent lands.**
2. **A uniform and scientifically defensible approach to assessing the impact of timber harvesting on fish habitat.**
3. **Timber harvesting shall not adversely affect water quality in terms of fish / fish habitat.**
4. **Timber harvesting will not harmfully alter the physical and water quantity aspects of fish habitat.**
5. **Timber management will not affect hydrology of surface and groundwater in a manner that harms, disrupts or destroys fish habitat.**

Two other possible objectives dealing with "net gain" and "public consultation" were considered by the group but were rated as less important.

3.5.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes). Discussion items or observations expressed by participants were recorded for each of the five points.

1. **Lack of Scientific Knowledge. (15)**
   - Need better knowledge and justification in determining setback distances from water bodies. What is the scientific basis?
   - Most areas of biology related to timber harvesting lack appropriate scientific knowledge.
   - More research should be directed at habitat problems/issues.
   - Need for guidelines appropriate to the regions.
   - Weak science base to support new concepts for timber harvesting.
   - Need for better knowledge transfer.
   - Communication and sharing of knowledge between researchers & decision makers.
   - No long term data.
   - Baseline information missing.
   - Scaling problem (regional inconsistencies in approach to legislation/policies).
   - Lack of inventory of fish and fish habitat resource collection protocols.
   - Ability to relate watershed level change to stream/resident fish/fish habitat change.
   - Need for understanding regional differences.

2. **Lack of Resources [people, dollars, capital assets]. (14)**

3. **Management. (12)**
   - Regional inconsistencies in legislation and policy.
   - Lack of database protocol.
   - Scale - appropriate for review and assessment.
   - Lack of integrated resource management planning to address cumulative impacts.
   - Timber harvesting management planning - too short a time horizon.

4. **Stakeholder Involvement and Consultation in Decision Making Process. (11)**
   - Socio-economic challenges - ecological choice conflicts , trade-offs.
   - Decision making processes not cognizant of fish/fish habitat values.
   - Differing expectations/vision.
   - Perceptions.
   - Value in protecting fish/fish habitat unclear to all parties.
   - Poor communication.

5. Jurisdictional Indecision. (9)

- Confusion of who is responsible for collecting and applying knowledge to achieve objectives.
- Jurisdictional barriers to managing fish/fish habitat.
- Current issue: resolving delegation of habitat issues between Federal and Provincial agencies.
- There may be differences among different areas in administration of habitat issues.
- Proponents may take advantage of these differences to avoid tight controls on their activities.

Two additional issues were also considered in the discussion:

1. Enforcement. (7)
   - Extensiveness of activities over a large landscape make it difficult to monitor and effect a change.
   - Lack of enforcement, e.g., jurisdictional escapees.
2. Empowerment. (2)

3.5.4 ACTIONS

The **top five actions** proposed by this group to address their list of barriers/gaps/opportunities were as follows:

TIMBER HARVESTING IMPACTS ON WATERSHEDS

Rating	Action	No. of Votes
1	**Research and development into scientific defensible monitoring tools/protocols [To address *Lack of Scientific Knowledge*].**	24
2	**Seek more resources e.g., partnerships, pooling, and more staff [To address *Lack of Resources*].**	13
3	**Promote administrative agreements to establish protocols:** **- who does what** **- monitoring** **- enforcement** **- performance [To address *Jurisdictional Indecision*]**	13
4	**Incentives to promote investment into timber harvesting management practices to achieve fish/fish habitat objectives** **- royalty fees to support timber harvesting activities for for fish/fish habitat [To address *Lack of Resources*].**	8
5	**Communication strategies, e.g., staff skills, who, what, where, when, messages [To address *Stakeholder Involvement*].**	6

Prior to voting for the top five actions, this group listed possible action items for each of the five barriers/gaps/opportunities as follows:

ACTIONS FOR TOP FIVE GAPS (Numbers in parentheses represent the number of votes on individual action items).

1. **Lack of Scientific Knowledge.**
   - Communication network between scientists and managers, universities (5).
   - Research and development into scientifically defensible monitoring tools and protocols (24):
     - more modelling,
     - GIS management tool with standard methods.
   - Method and means of determining what research and development is required.
   - Support and build on existing efforts (1)

2. **Lack of Resources (people, funds, capital assets).**
   - Seek more resources (13):
     - partnerships,
     - pooling,
     - more staff.
   - Incentives to promote investment into timber harvesting management practices to achieve fish / fish habitat objectives (8):
     - royalty fees to support timber harvesting activities for fish/fish habitat.

3. **Management.**
   - Obtain commitment from resource manager to look at large scale planning (1).
   - Political commitment.
   - Increased communication amongst jurisdictions (1).
   - Sub-political cooperation.

4. **Stakeholder Involvement and Consultation In Decision Making Process**
   - Extend capabilities by streamlining to achieve focus on communication message.
   - Communication strategies , e.g., staff skills, who what where, when , messages (6).
   - Strategies for consensus building (1).

5. **Jurisdictional Indecision**
   - Clarify responsibilities/expectations (4).
   - Administrative agreements to establish protocols (13):
     - who does what,
     - monitoring,
     - enforcement,
     - performance.

3.5.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

TIMBER HARVESTING IMPACTS ON WATERSHEDS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	55	33	12
Are the gaps important?	45	39	16
Do the actions have value?	48	42	9

FACILITATOR: Ken Crutchfield

RECORDER: Fred Hnytka

3.6 INSTREAM FLOW NEEDS

3.6.1 BACKGROUND

Instream flow is "the required amount of water flowing in a stream to sustain aquatic organisms and processes." The objective of an instream flow recommendation is to provide flows that mimic the natural hydrograph for which stream flow variability within a year and over several years is recognized.

Methods to determine instream flows first appeared in the published literature in the 1960's. However, as the demand for water increased worldwide, so too did the need to develop instream flow models. As a result, models now exist for various users (e.g. fish, mussels, wildlife, riparian areas, recreation), stream types (i.e. bedrock or alluvial) and geographic regions (e.g., New England method).

Instream flow methods for fisheries are usually categorized as discharge, hydraulic rating, or habitat preference models. Most models are not without their critics. Tennant's method and Tessmann's modification of Tennant's method are two commonly used discharge methods which are the simplest, least expensive and time consuming of the three categories to conduct. Discharge methods assess historical streamflow records and often express the instream flow requirement as a fixed percent of mean or median, annual or monthly flow (e.g. 40% of mean monthly flow). These methods tend to be conservative and at times recommend an instream flow that cannot be met. Hydraulic rating methods employ single or multiple transect data to develop hydraulic rating or habitat-discharge curves that describe the variation of a physical habitat parameter with discharge at a specific location. The wetted perimeter inflection point method is a hydraulic rating method. This suite of methods is intermediate in cost and complexity but are limited by being site specific. The instream flow incremental methodology (IFIM) is an example of a habitat preference method. IFIM allows the quantification of suitable habitat in a stream reach over a range of discharges on a species-specific and life stage-specific basis. Habitat preference methods tend to be the most complex and expensive instream flow assessment methods. However, these models are good for impact prediction and tradeoff assessment.

"Straw Man" Objectives:

1. Ensure sufficient water flow to sustain aquatic organisms and processes.
2. A common basis for calculating IFN (instream flow needs) requirements.

3.6.2 LIST OF OBJECTIVES

The breakout group provided the following three objectives after a period of discussion:

1. **Ensure appropriate timing and quantity of flows to sustain aquatic processes.**
2. **Provide a common basis for calculating IFN requirements.**
3. **IFN objectives that are adaptive to changing needs e.g. climate change; change in**

watershed residents' values or ecosystem awareness.

3.6.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes):

1. **Research: regional multi-disciplinary IFN oriented research is needed. (14)**
2. **Expand education programs on IFN application to water use to promote sound watershed development. (8)**
3. **Collaboration is needed between different agencies in dealing with IFN e.g., a regional working group (with possible private sector involvement) to deal with the process (8)**
4. **Technofear: a term describing the fear of, or an aversion to acquiring the knowledge and the application of a concept or technique because of a preconceived complexity. (8)**
5. **Develop partnerships with water users (irrigation groups, hydropower agencies) and resolve conflicts. (8)**

The breakout discussion which produced the above list covered numerous observations and topics which are summarized as follows:

Opportunities:

- Research: There is a need for regional multi-disciplinary IFN oriented research that encompasses hydrological and biological parameters, physical habitat and productive capacity in flowing waters. Are we able to quantify, for example, the biological contribution of intermittent streams in a watershed?
- Establish partnerships or collaboration between different agencies to deal with IFN in the region.
- Provide opportunities to manage flows appropriately for fish. This is not practical for low head dams or weirs.
- Better integration of IFN into fisheries management plans and objectives.
- Seek funding or partnership opportunities from other sources i.e., private sector, hydroelectric companies.
- Promote education programs on integration of water use and IFN principles to promote sound watershed management and fish habitat protection.
- Knowledge transfer with respect to applicability and uses of different IFN models/techniques (what are the pro and cons of each model?).
- Put more resources into educating engineers and biologists and watershed planners on IFN.
- Use environmental assessment process to incorporate IFN into legislation and guidelines.
- Work towards standardized models/methods between provincial jurisdictions - let's manage watersheds regardless of provincial boundaries.
- Pro-actively monitoring that IFN are being complied with - do we monitor effectively?

- Develop pro-active non-adversarial approaches to resolving conflicts among multiple users.

Barriers:

- Financial barrier is omnipresent.
- Conflict, between federal/provincial agencies, on IFN and other uses.
- Conflicting legislation (provincial water acts versus federal *Fisheries Act*).
- Confusion regarding the roles, responsibilities and policy between government agencies.
- Non-conforming dams built prior to legislation.
- Lack of baseline data.
- Habitat ignorance i.e., lack of adequate education on policy and legislation.
- "Technofear." A term describing a strong aversion to acquiring the knowledge or applying a technique because of it's complexity , e.g. the technical aspects of IFIM. As a result there is reluctance or avoidance to apply such methods in stream habitat assessment and management.
- Reluctance to tell proponents to go back and apply IFIM because it will delay a project; we fear that we may not have the resources to evaluate the data when we receive it.
- Lack of time to deal with IFN issues - we seem to need answers now when water use issues arise.

3.6.4 ACTIONS

The **top five actions** proposed by this group to address the list of barriers/gaps/opportunities were as follows:

INSTREAM FLOW NEEDS

Rating	Action	No. of Votes
1	**Training for biologists and regulators in IFN and river management techniques..**	14
2	**Research to clarify the links from flow to habitat to biomass**	13
3	**Comparison of various IFN methods at a standardized site to facilitate our understanding of each method's potential/limitations.**	10
4	**Public education on IFN: use internet, factsheets, public meetings.**	9
5	**Establish an IFN Working Group for the region to set common goals and to provide direction for research.**	8

Prior to voting for the top five actions, this group created a list of possible action items for each of the five barriers/gaps/opportunities as follows:

1. **Research Needs**:
   - Prioritize regionally and determine where to concentrate research.
   - Identify regional expertise.
   - Conduct a comparison of IFN methodology and results at one standard location.
   - Establish the link between flow, habitat and biomass.
   - Prairie Provinces/DFO Science Agreement should be established to promote collaboration on science.

2. **Expand Education**:
   - Promote training for biologists/engineers/water regulators in IFN methods.
   - Promote public education with regard to IFN requirements in water use projects through the internet, fact sheets/publications, and public meetings.
   - Look for funding sources for education.
   - Develop guidelines for proponents: legislation, policy, recommended methods.

3. **Collaboration in research process**:
   - An IFN group from across region should meet regularly.
   - Collaborate on educational materials i.e. what is available and should new ones be produced?
   - Use Instream Flow Council.

4. **Information Exchange via the Internet and World Wide Web**:
   - Develop or support a Website specifically for IFN issues.
   - Develop a newsgroup for IFN.
   - Develop an internet mailing list for continuing dialog on IFN topics.

5. **Overcome "technofear"**:
   - Provide training for biologists and water regulators in IFN methodology and river management techniques.
   - In the development of models and methodology, aim for a user-friendly product.

6. **Develop partnerships and resolve conflicts**:
   - Provide training in mediation and conflict resolution.
   - Create a work unit for public involvement and conflict resolution.
   - Fisheries biologists should be proactive in the transfer of information at meetings and working groups.
   - Develop formal partnership agreement with other government agencies, or citizen groups with a vested interest in a watershed e.g., irrigation groups.
   - Provide incentives to encourage partnerships.

3.6.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

INSTREAM FLOW NEEDS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	63	38	0
Are the gaps important?	70	24	6
Do the actions have value?	70	24	6

FACILITATOR: Christine Stoneman

RECORDER: Henry Majewski

3.7 HYDRO PEAKING

3.7.1 BACKGROUND

Demand for hydro power peaks at certain times of day. Water is released at these times to meet peak hour demand. Dams and generation plants were commissioned decades ago with little consideration or knowledge of the effects of these operations on downstream fisheries resources. However, large fluctuations in flows over short durations have obviously impacted downstream fish and fish habitat. Hydro peaking is not restricted to facilities responding to daily demand because there is also the broader issue of flow modifications other than daily, e.g., hourly, weekly or seasonally.

Habitat managers are currently faced with the challenge of assessing the historical impacts that were caused and continue to be induced by these facilities as well as developing remedial measures, or mitigation processes for hydro peaking operations.

"Straw Man" Objectives:

1. A consistent and predictable approach to be used by habitat managers in addressing this issue.
2. A scientific basis for assessing historical impacts.
3. A shared set of remedial and mitigative approaches.

3.7.2 LIST OF OBJECTIVES

The breakout group provided the following **three objectives** resulting from their discussion:

1. **Daily and seasonal fluctuations in flow should not diverge from the natural hydrograph sufficiently to cause major impacts (HADD) to aquatic life.**
2. **A scientific basis for assessing and/or recommending changes to existing facilities or operations (legal operations as well as older, non-conforming operations).**
3. **Develop or identify a shared set of remedial and mitigative approaches to achieve targets of all resource users/interests, e.g., proponents/resource managers.**

3.7.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five gaps/opportunities** with respect to addressing the objectives (Numbers of votes not available):

1. **Conduct research on habitat and fish species up/down stream affected by hydro peaking.**
2. **It is more costly for power producers to discharge at off-peak times.**
3. **Develop partnerships with power producers to develop/research efficiencies.**
4. **Determine how much water is necessary for the resource.**

5. Use of relevant sections of the *Fisheries Act* ; also consider instream flow needs.

The discussions leading to the formulation of the above list considered other comments and ideas which are summarized as follows:

Opportunities:

- Use the opportunity to change operating strategies and infrastucture (eg. turbines, fishways, dams etc.) when waterpower leases come up for renewal.
- Conduct research on habitat/fish species affected by hydro peaking (upstream and downstream).
- Investigate European style pump-storage operations.
- Develop partnerships with power producers to research and develop efficient operations.
- Use section 22 of the *Fisheries Act* when negotiating operating regimes of dams with power producers.
- Ensure that hydraulic assessments are conducted for maintaining wetted perimeter.
- Pursue opportunities to enhance productive capacity by flow regulations during critical life stage periods (i.e., migrations, spawning, incubation).
- Price/contract - structure to influence operating plan.

Gaps:

- There are many opposing interests in the resource: community, recreational, subsistence fishing, and resort users.
- Time limitation imposed on resource managers to resolve with power producers the perceived or real impacts of peaking operations.
- Increased cost will be a burden on power producers if forced to discharge at off-peak times.
- Pre/post research considerations: what is the current knowledge base and time needed to acquire adequate information? There's always a concern about false versus real expectations.
- We don't know how much water to ask for as resource managers (some versus lots).
- There will be consumer reluctance to accept higher costs in return for habitat.
- Another conflict: Conservation of Energy vs. Conservation of Habitat

3.7.4 ACTIONS

The group noted at this stage that their top 5 gaps/opportunities, as presented, could be viewed as action items. Consequently, with some rewording, their list of **top five actions** was as follows (Number of votes for the second to forth action were not reported):

HYDRO PEAKING

Rating	Action	No. of Votes
1	**Research on habitat species up/downstream affected by hydro peaking.**	12
2	**Need to obtain site specific IFN related to specific operations.**	n.r.
3	**Develop and promote specific education programs for the public/consumers.**	n.r.
4	**Develop research tools for peaking hydraulics with the goal to protect fish and fish habitat.**	n.r.
5	**Establish how much water is needed for the resource to protect the upstream/downstream fishery.**	7

n.r. = not recorded

The discussion leading to the formulation of the above action items was abbreviated by lack of time. Topics that were discussed included:

- Need to understand cost/benefit analysis to apply monetary pressure to change or dictate operating plans. (Better resource economics is required)

- Develop research tools for peaking hydraulics to protect fish and fish habitat. While we appear to have a good understanding of hydraulic processes in natural flowing systems, the group perceived that we seem to be lacking the tools to gauge peaking hydraulics.

- Site specific IFN studies related to specific operations/river reaches must be done so that we can better understand how much flow to ask for and to allow an evaluation of alternatives for this river reach.

- Use the *Fisheries Act* and IFN as the main tools.

- Develop and promote educational programs for the public/consumers to teach them the link to fish/fish habitat. Examples of such programs are the "Yellow Fish Road" program; the "Save a Fish, Turn off the Light" program used in the Nipigon area.

3.7.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

HYDRO PEAKING

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	61	30	9
Are the gaps important?	58	39	3
Do the actions have value?	56	44	0

FACILITATOR: Ed DeBruyn

RECORDER: Karen Gray

3.8 AGRICULTURAL TREND AND ANTICIPATED IMPACTS

3.8.1 BACKGROUND

Increased agricultural intensity in Canada is threatening fish habitat. Increased potato and hog production, for example, are two agricultural trends with implications for fish and fish habitat. In Manitoba, irrigators are predicting a potential increase of 30,000 acres of potatoes in production within five years. Similarly, swine production is expected to double in the near future. With the cancellation of the Crow Rate grain transportation subsidy, grain producers are seriously considering the option of selling their crops to prairie hog producers for feed. Manitoba expects to have three potato processing plants within five years, and a new hog processing plant is scheduled to come on-line in the next two years. Moreover, the province is actively recruiting hog producers from Amsterdam and Belgium.

In Alberta, there has recently been considerable media coverage about the increase in feed lot operations at which hogs and cattle are raised intensively. Residents near Lethbridge have complained that both the air and the water are being polluted by the intensive livestock operations. Recent media coverage in Manitoba is focusing, among other subjects, on environmental impacts of the proposed hog operations in Brandon that may not be adequately addressed as project approvals are incrementally granted.

"Straw Man" Objectives:

1. Ensure that intensive agriculture methods do not harm fish habitat.
2. Improve trend analysis and ensure that habitat management guidelines are anticipating changes in agriculture.
3. Improve cumulative effects prediction of multiple agricultural changes within a watershed.

3.8.2 LIST OF OBJECTIVES

The breakout group provided the following **four objectives** after a period of discussion:

1. **Ensure that all agricultural practices do not harm fish and fish habitat.**
2. **Ensure that agricultural practice guidelines incorporate habitat management practices to protect fish/fish habitat.**
3. **Address the cumulative effects (from point and non-point sources) and the prediction of multiple agricultural projects within a watershed.**
4. **Foster stewardships, partnerships and both public and government awareness of agricultural impacts.**

The discussion leading to the formulation of objective number two was prompted by a query on whether specific guidelines relating agriculture and fish/fish habitat do exist? It was indicated that some guidelines are available but for certain agricultural practices only. Instead of creating totally

new guidelines, the group felt that more effort should be directed towards an updating of existing guidelines. The goal is to adapt and modify guideline elements to create dedicated guideline(s) for each agricultural practice.

3.8.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers of votes were not reported):

1. **Utilize existing provincial and federal organizations to promote good land use programs.**
2. **Enforce existing legislation; impose higher fines; consider "carrot and stick" tradeoffs.**
3. **There is a lack of integrated guidelines to improve agricultural practices within a watershed. Some guidelines exist but these originate from specific agencies (wildlife, fish, water).**
4. **Promotion of good land use stewardship is not coordinated despite proliferation of information.**
5. **Insufficient acknowledgement of good stewards and their specific efforts.**

The discussion focusing on gaps/barriers/opportunities covered observations and topics which are summarized as follows:

Opportunities:

- Use existing opportunities to promote environmentally friendly programs.
- Use existing legislation to regulate practices.
- Provide information on environmentally friendly agricultural practices.
- Provide integrated guidelines for better land use.
- Provide a mechanism for sharing information.
- Have the ability to provide specific information for both large and small operations.
- Encourage technology aimed at the bio-conversion of manure.
- Encourage stiffer penalties for violations but consider carrot and stick tradeoffs.

Barriers:

- Competing dollar incentives from other sectors does not promote environmentally friendly land use practices.
- Insufficient knowledge (research) to assess impacts of agricultural practices.
- There's a lack of integrated fish management plans in watersheds impacted by agricultural activities.
- There seems to be no reward or acknowledgement for examples of good practices.
- Multiple, uncoordinated approach to promoting good land stewardship is not evident and current efforts seem uncoordinated.

- Proliferation of information may exist but there is uncertainty about who is receiving the information.

3.8.4 ACTIONS

The **top five actions** proposed by this group to address the list of barriers/gaps/opportunities were as follows:

AGRICULTURAL TRENDS AND ANTICIPATED IMPACTS

Rating	Action	No. of Votes
1	**Collate guidelines to eliminate redundancy and identify gaps.**	18
2	**Establish financial partnerships, at both national and provincial level, with industry and vested interest groups e.g., farm machinery and agrochemical producers.**	13
3	**Encourage shift in land use practices e.g., from traditional but detrimental practices to environmentally friendly ones.**	10
4	**Develop an enforcement strategy that involves the commitment and cooperation of federal and provincial agencies.**	10
5	**Establish environmental articles/columns to highlight positive, good news stories e.g., in "Western Producer" magazine.**	9

3.8.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

AGRICULTURAL TRENDS AND ANTICIPATED IMPACTS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	81	19	0
Are the gaps important?	72	25	3
Do the actions have value?	75	22	3

FACILITATOR: Joel Hunt

RECORDER: Keith Kristofferson

3.9 CHANNELIZATION AND DRAINAGE

3.9.1 BACKGROUND

Constructed drains (municipal or agricultural drains) through the channelization of existing watercourses and the regular clean out (dredging) of drains is common practice. Drain channelization activities are deemed necessary to maximize agricultural purposes or to maximize municipal land use activities. As more pressure is exerted on both urban and rural land use to obtain maximum performance (e.g., building lots per hectare, irrigation needs, stream flood plain and band width reduction and straightening), aquatic resource managers will be asked to make fish and fish habitat decisions.

Many of these decisions are being made for proposals that deal with only a small piece of a larger watershed. On an individual basis small projects appear benign but when viewed in the watershed or sub-watershed context, there is a cumulative pattern of impacts to fish and fish habitat. Decisions on channelization or drainage proposals for rural or urban development made today will have both short and long term consequences on fish and fish habitat not only within the channelized portions but also in the connecting watercourses up or down stream.

The impacts of stream channelization and drain maintenance on fish and fish habitat need to be addressed in the decision making process. Aquatic resource managers need decision support tools to provide them with regular and consistent decisions that have both a small and broad scale applications. Ultimately, developing a standard set of decision tools could have a national application.

"Straw Man" Objective:

1. A standard set of decision tools which will guide decisions about channelization and drainage.

The group assigned to this topic was also provided with a supplementary list of additional ideas to ponder during discussion:

- Do you differentiate between urban and rural channelization projects (are they managed differently) versus works within a 'natural' stream?
- What standard assessment or decision tools are used in your area?
- What do we know (research) about the impacts of channelization on fish and fish habitat management?
- Are the guidelines broadly known or proven?
- Has science (research) provided a basis to support standard approaches for channelization?
- Can natural channel design principles be applied in channelized systems to address fish and fish habitat concerns?
- What are the standard mitigation or compensation measures used to offset impacts to fish and fish habitat?

- Use of habitat banking to compensate for a number of small scale projects to complete large scale habitat rehabilitation projects. Is habitat banking an option for ad hoc channelization works?

3.9.2 LIST OF OBJECTIVES

The group determined that there was really the **one major objective**:

1. **Ensure that channelization and drainage activities do not have a negative impact on fish and fish habitat.**

3.9.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objective (Numbers in parenthesis represent the number of votes):

1. **Unwillingness to incorporate the needs of other interest groups into drainage designs. (16)**
2. **There is insufficient analysis of true costs for drain construction. (14)**
3. **Lack of enforcement. (10)**
4. **Conflicting legislation and administrative policy. (10)**
5. **Insufficient analysis of watershed impacts. (10)**
6. **Insufficient knowledge by public and professional groups of impacts of non point source pollution. (9)**

The discussion preceding the creation of the above list covered numerous comments or observations that included:

- Engineers have been accused of showing unwillingness to incorporate the needs of other groups in their designs.
- Engineers may pursue the most efficient design to convey water only at the lowest cost.
- Cost/benefit analysis seems limited to economic terms only and not much attention is given to environmental values especially when many projects are marginally feasible in economic terms.
- Who pays for extra cost to protect habitat?
- Farmers also need to be convinced of the need for new designs.
- Conflicting legislation can be a problem. In Ontario, for example, the conflict between the Drainage Act and the *Fisheries Act* may create administrative hurdles.
- All provinces agreed that drainage systems are viewed similarly in the sense that if fish use them then it is considered fish habitat.
- It is difficult to sell farmers on the need to create habitat for "minnows".
- Lack of enforcement is a universal problem. The *Fisheries Act* should be applied more

often.

- Cumulative impacts: By focusing only on a specific river reach or project site, the cumulative impacts on the whole watershed may be overlooked.
- Downstream effects/impacts should not be overlooked.

3.9.4 ACTIONS

The **top five actions** proposed by this group to address the list of barriers/gaps/opportunities were as follows:

CHANNELIZATION AND DRAINAGE

Rating	Action	No. of Votes
1	**Develop a standard set of tools to guide decisions that will protect fish and fish habitat. Such tools do not exist.**	12
2	**Demonstration of alternatives to drainage personnel through educational workshops and seminars. This aspect includes more inter-agency cooperation and more professional interactions.**	10
3	**Better definition of intra-Government responsibilities and actions is required. There must be common policies and objectives towards drainage/channelization within different government agencies.**	9
4	**Compile examples of successful drains that include habitat structure. Success stories should be used to reinforce our habitat protection efforts.**	8
5	**Ensure that integrated resource management plans and land use planning efforts are considered. These procedures are required to enable assessment of cumulative impacts to the watershed.**	7

Other action items proposed in the breakout discussions included:

- Enforcement of the *Fisheries Act*.
- Financial incentives. Government agencies often lose credibility because they are unwilling or unable to inject seed money to encourage farmers to address fish/fish habitat issues.
- Investigate alternative methods for placing value on fish habitats e.g., the concept of Natural Capital was mentioned.
- The facilitator indicated that there was insufficient time for the group to address the list of "additional areas to ponder" provided in the background document.

3.9.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

CHANNELIZATION AND DRAINAGE

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	69	25	6
Are the gaps important?	88	6	6
Do the actions have value?	88	13	0

FACILITATOR: Karen Ralph

RECORDER: Bill Bond

3.10 ROAD CROSSINGS

3.10.1 BACKGROUND

Poorly designed and constructed road crossings of streams and rivers can be highly detrimental to fish and fish habitat. Crossings must be designed and constructed in a manner that protects and conserves fish habitat on site and downstream. Despite years of study, and the existence of construction and maintenance guidelines, road crossings still cause a major impact.

Generally speaking, construction of road crossings at streams and rivers requires consideration of several factors. These include but are not necessarily restricted to:

- Activities associated with road crossings construction and ongoing operation,
- Determining impacts of these activities on fish habitat,
- Determining how and where to mitigate these impacts, and
- Determining information required to develop mitigation and /or compensation for these activities.

"Straw Man" Objectives:

1. Unobstructed movement of fish under built road crossings.
2. Minimal impact on fish habitat during road crossing construction.
3. Remediation measures which can be applied to existing problem crossings.

3.10.2 LIST OF OBJECTIVES

The breakout group provided the following **five objectives** as a result of their discussions:

1. **No blockage of migration as a result of perched culverts, high velocity events or failure to ensure minimum water depth in culvert structures.**
2. **Short term sediment input into water is kept to lowest practical level.**
3. **A newly completed crossing or a decommissioned site will be stable with no ongoing erosion/sediment into water.**
4. **Seek to minimize the time required by regulators in reviewing and monitoring projects. Shift as much responsibility to developers as possible.**
5. **No net loss will occur at road crossings and, if possible, enhance fish habitats at such sites.**

Additional topics covered in the group's breakout discussion included:

- Culvert installation could be a HADD and thus require authorization under the *Fisheries Act*; however, the type of compensation may not be readily apparent or practical.
- The group also agreed that culverts serve as habitat to some extent, especially if designed

with baffles so that substrate accumulates inside the pipe.

3.10.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parentheses represent the number of votes):

1. **Fisheries values are not recognized in planning and design phase (i.e., fish passage, erosion control, natural channel hydraulics). (16)**
2. **There is a lack of access to training programs for designers, builders and regulators to ensure that they gain and maintain a level of competence. (12)**
3. **There is insufficient sharing of knowledge. This situation suggests a need and an opportunity to establish a national clearing house of habitat information. (11)**
4. **There is a lack of detailed site specific knowledge of habitat and species. This data should be provided by the proponent. (10)**
5. **There is a lack of monitoring and inspection of road crossing projects because of a reluctance to enforce legislation, staff shortage, no funding and insufficient knowledge. (10)**

The group discussion was very focused and organized. A variety of topics and observations were put forth and documented as follows:

Barriers:

- Lack of monitoring/inspection of temporary crossings in remote northern areas. There is reluctance to enforce legislation, especially amongst government agencies. Shortage of staff and funding may be the underlying reasons.
- Inadequate knowledge. When is a culvert too long? Research is required on various fish species in terms of the swimming capabilities of mature fish and the response of various life stages in relation to culvert hydraulics.
- There appears to be no consistent policy for remediation and there is a lack of some standardized approach in dealing with problem crossings. Who has the long term responsibility for a crossing gone bad?
- Adequate or inadequate designs have occurred. Provision for long term maintenance may or may not exist. High quality crossings may be expensive. It's always cheaper to build a culvert than a bridge.
- Engineering plans may be inadequate.
- Lack of guidelines on the design and appropriate use of different types of culverts; this would be most useful to municipalities.
- Designers (engineers) and planners are not factoring in the fisheries values (i.e., fish passage, erosion control, natural channel hydraulics etc.
- Integrate knowledge transfer among engineers, biologists, equipment operators, consultants, and the public.
- A common problem is the lack of detailed site specific knowledge of fish habitat and the fish species assemblage. Proponents should be required to provide information needs.

Regulators should also be able to provide proponents with a list of information requirements.

- Sharing of knowledge between jurisdictions may not be sufficient.
- There is a lack of access to training programs for designers, road builders to gain and maintain competence. Regulators also require training on biological and engineering aspects of road crossings.
- There seems to be a lack of knowledge and tools to determine cumulative effects of numerous crossings in a watershed.
- Inadequate reclamation procedures, such as poor stabilized slopes, impede progress in protecting habitat.
- There is a gap in knowledge on how to apply the No Net Loss (NNL) concept or to attempt net gain / enhancement at crossing sites.

Opportunities:

- Research programs are always on the wish list.
- Engineers should be challenged to design towards fisheries objectives. We should encourage the use of bridges on "low volume roads" (a terminology for bush roads in the USA) by providing simple standard designs.
- To address the insufficient sharing of knowledge, we should establish a national clearing house for habitat guidelines and information, e.g., via the internet.
- Promote public opinion drives. ISO 14000 certification, for example, encourages environmentally friendly forest road crossings and provides an opportunity to form partnership with road builders.
- Educate the public on the implications of poor crossings.
- Develop protocols to streamline the approval process with standard predetermined processes and conditions developed co-operatively with industry.

3.10.4 ACTIONS

The **top five actions** proposed by this group to address the list of barriers/gaps/opportunities were as follows:

ROAD CROSSINGS

Rating	Action	No. of Votes
1	**Conduct workshops for road builders; promote training programs for designers, builders and regulators. Make training a requirement under "code of practice" and permitting process.**	11
2	**Make it a requirement that developers provide fish habitat/species information as part of approval process.**	10
3	**Develop a web site to include:** **- guidelines** **- registry of habitat practitioners** **- access for discussion and help on issues.**	9
4	**Biologists (regulators) should be present at pre-design meetings of road builders. Their role is bring habitat issues to the forefront by advising on information requirements for fish and fish habitat and the site specific conditions to protect fish.**	7
5	**Authorizations/permits to include long-term monitoring conditions and contingency plans.**	6

The discussion preceding the formulation of the above top actions was also very organized; the group recorder provided full documentation of the series of possible actions proposed to address each of the top five gaps:

Fisheries values not recognized in planning and design (Gap #1):

- Biologists (regulator) should be present at pre-design meetings of road builders to advise on information requirements, site specific conditions to protect fish and to impart knowledge of fish and fish habitat.
- Ensure appropriate fisheries input to Codes of Practice, where they exist.
- Promote inter-department meetings/summaries.
- Seek pro-active attendance at highways/forest company meetings.
- Provide fact sheets/checklists for road builder.
- Do our homework.

Lack of access to training programs for designers, builders and regulators (Gap #2):

- Run workshops for road builders.
- Conduct training programs for designers, builders and regulators.
- Ensure the trainers are also given updated training.

- Utilize existing educational institutions/various strategies.
- Training should be a requirement under Codes of Practice or required under Permit.
- There must be a commitment from government departments for training.

Insufficient sharing of knowledge that could be addressed by establishing a national "clearing house" of habitat information (Gap #3):

- Create a web site to provide the latest guidelines, a project registry, and provide access to discussion or help on issues.
- Conduct regular workshops with the participation of several jurisdictions.
- Develop a registry of habitat professionals (could be included in web site).

Lack of detailed site specific knowledge of habitat / species (Gap #4):

- Require developer to provide information as a requirement of approval process.
- Regulators should define information needs and standards and timeline requirements.
- Develop and support accessible databases.
- Promote partnerships with proponents to gain fish and habitat information.

Lack of monitoring / inspections; reluctance to enforce; shortage of staff/funds (Gap #5):

- Facilitate the sharing of monitoring personnel.
- Encourage staff by providing adequate training in compliance monitoring.
- Encourage self-regulation (industry wide training and ground truthing).
- Authorizations should include long-term monitoring conditions and contingency plans.
- Teach proponents the benefits of compliance e.g., case history documentation.
- Use environmental monitors to be specified by regulator.
- Enforce the *Fisheries Act* when required.

3.10.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

ROAD CROSSINGS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	69	31	0
Are the gaps important?	84	13	3
Do the actions have value?	74	23	3

FACILITATOR: Rick Orr

RECORDER: Henry Majewski

3.11 PIPELINE CROSSINGS

3.11.1 BACKGROUND

Stream crossings associated with gas and oil activities, agriculture irrigation projects and municipal water supply works are common in the prairie provinces. Impacts of these pipeline crossings on fish habitat are well known. What is required is for both the regulatory agencies and industry to have better appreciation of the issues involved and work together to prevent, ameliorate and mitigate impacts through appropriate engineering design, better construction, operation and maintenance measures.

"Straw Man" Objectives:

1. Minimal impact on fish habitat and fish during pipeline crossing construction.
2. Remediation measures which can be applied to existing problem crossings.

3.11.2 LIST OF OBJECTIVES

This breakout group had spent most of their time on the preceding road crossings session and was left with little time to deal with this second assigned topic with equal intensity. Nevertheless, they managed to complete this assignment The objectives that they developed were as follows:

1. **Minimize habitat impacts at pipeline crossings.**
2. **Remediation measures at existing problem crossings should be pursued:**
   - The opportunity to do restoration and remedial work would occur, for example, if a right-of-way for another pipeline is proposed.
3. **Short term sedimentation into the watercourse must be kept to the lowest level.**
4. **Consequences of sedimentation on downstream habitat must be minimized:**
   - Research may be needed to document short and long term effects.
5. **The best habitat management practice is to promote dry crossings over wet crossings:**
   - In Ontario, a wet crossing is considered a last resort that will require compensation under Section 35 of the *Fisheries Act.*
6. **Consistent protocols for pipeline crossings that are applicable across the country.**

3.11.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** (The number of votes were not recorded):

1. **There is a lack of consistency in dealing with pipeline crossings across the country.** Each region may have different protocols for processing pipeline proposals. In addition, lack of consistent standards between regions (e.g., sediment control) create complications for both regulators and a proponent when a pipeline crossing several

provinces is proposed.

2. **There is a lack of coordinated planning for different pipelines that will allow, for example, a shared right-of-way to minimize cumulative impacts.**
3. **Pipeline crossings do not incorporate natural channel design**.
    - Pool and riffles designed into a crossing may provide better habitat.
4. **Wet channel crossings have data/knowledge gaps:**
    - Major gaps exist in understanding sediment deposition. Mr. Bruce Adamson cited attempts made to predict where sediment is deposited. Although accuracy of sediment deposition data was not certain, it seemed that much sediment was deposited in interstitial spaces and not simply carried away.
    - Short term and long term effects are still unknown.
    - Time span for self cleansing is still unknown.
    - Protocols for data collection in a consistent manner by proponents are required.
5. **Research required on sediment effects and control**.
    - Form partnerships with proponent to obtain funding for research.
    - National Pipeline Water Course Crossing Committee have some guidelines.
    - Canadian Association of Petroleum Producers (CAPP) guidelines are being rewritten.
    - Crossing preferences vary; companies prefer wet crossings whereas regulators prefer dry crossings.

Several additional gaps and action items were also considered in the short time span that was available:

- Cumulative effects of associated activities for the whole length of a pipeline may not be a primary consideration:
    - Roads,
    - Storage areas,
    - Right-of-way terrain/vegetation,
    - Base camps,
    - Garbage and waste disposal.
- Communication problem - proponents don't know what provincial and federal agencies they have to deal with. Cross-training to address this aspect is important.
- Lack of co-operative management e.g. co-ordinate pipeline right-of-way for two or more independent pipeline companies.
- Lack of early pre-planning meetings with all regulators (fish, wildlife, etc) to facilitate design and scheduling of pipeline project/crossings.
- No standards are in place for surveillance, upgrading or replacing ageing pipeline crossings. Many old pipelines are not monitored to detect deterioration.
- Education problem – proponents and regulators may not be fully cognizant of the cost/benefits/environmental risk of different crossing options.
- Education/training needed to standardize wet crossings – there must be a process to collate information from previous experiences or case histories to learn in which situations wet crossings have worked.

- Pipeline workshops provide a valuable mechanism for educating both regulators and the industry.
- A stream that is frozen solid is regarded as a dry crossing.
- Natural channel designs should be encouraged, e.g., creating pools and riffles. The cost to do this may be cheaper as well as providing better habitat in the end.

3.11.4 ACTIONS

Actions proposed during discussion essentially addressed each of the gaps listed. The top six actions voted by the group were as follows (Number of votes not available).

PIPELINE CROSSINGS

Rating	Action	No. of Votes
1	**Encourage regulatory agencies (e.g. National Energy Board) to co-ordinate common standards across the country.**	n.a.
2	**Encourage companies to plan ahead and co-ordinate adjacent or concurrent projects.**	n.a.
3	**Develop better wet-crossing designs and standards if dry crossings are not possible.**	n.a.
4	**Sedimentation research and impacts should be done with involvement of proponents.**	n.a.
5	**Promote the use of natural channel designs for pipeline crossings.**	n.a.

3.11.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

PIPELINE CROSSINGS

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	69	22	9
Are the gaps important?	59	38	3
Do the actions have value?	57	43	0

FACILITATOR: Bruce Adamson

RECORDER: Jennifer Merkowsky

3.12 GRAVEL REMOVAL

3.12.1 BACKGROUND

For several decades active watercourse channels and adjacent floodplains have provided a readily accessible, and so called "renewable" source of sand and gravel resources. These aggregate resources are used primarily in road construction and maintenance. It is anticipated that the demand for aggregate resources will increase as a result of increased resource development (e.g., forestry, oil and gas). It is also anticipated that as known upland aggregate sources are depleted, resource extraction will become more concentrated and focused on sites in watercourse channels and floodplains.

The extent, nature and environmental impacts of aggregate extraction from watercourses and floodplains are poorly understood. More specifically the impacts of extraction on aquatic ecosystems, fish and fish habitats, and channel morphology need to be better understood. Scientifically-based guidelines for extraction activities, that ensure the long term integrity of aquatic ecosystems, need to be developed.

"Straw Man" Objectives:

1. Improved understanding of the impact of aggregate extraction from watercourses and floodplains on fish habitat.
2. Science-based guidelines for acceptable practices in aggregate extraction activities.

3.12.2 LIST OF OBJECTIVES

The breakout group provided the following **three objectives** after a period of discussion:

1. **Improved understanding of the impacts of the aggregate extraction from watercourses and floodplains.**
2. **Science based guidelines for acceptable practices in aggregate extraction activities to ensure No Net Loss.**
3. **Increase inter-jurisdictional knowledge transfer.**

3.12.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes):

1. **Indifference to the issue. (18)**
2. **Lack of clear science to determine harmful impacts to fish and fish habitat. (18)**
3. **Lack of education among developers, contractors and regulators. (9)**
4. **The issue involves several regulatory jurisdictions with divergent objectives within a**

region or province thereby extending the scope of a project beyond a simple fisheries issue. (6)

5. **Lack of resources to conduct research, inventory and monitoring programs, and to provide education and enforcement. (2)**

Discussion in this breakout group revealed that gravel or aggregate removal was not viewed with equal importance among jurisdictions represented. Only Alberta perceives gravel removal as a major problem, one reason being the occurrence of gold mining operations that involve sluicing, an activity that is comparable to aggregate removal. Sluicing is an old tradition and its practice has not been favorable with respect to NNL or protection of fish habitat. Government regulators have tried to mitigate by using timing windows (e.g. at low water period) and public education.

Alberta has managed to get most users "out of the water", but activities still occur in the active channel and impacts to other water users downstream is unclear. Cumulative effects on a watershed need to be addressed. Lower gradient watercourses that may have accumulated gravel only through glaciation may be most adversely affected as their low flow velocities are unable to redistribute the bed load. In such cases gravel extraction cannot be considered a sustainable activity.

Aggregate removal occurs in foothill streams as well as larger watercourses in Alberta and currently there is no resistance from other user groups. There is a lot of non-authorized aggregate removal in Alberta with a majority of users being described as small operators. Although the *Fisheries Act* is in place, enforcement was described as non-existant. Furthermore, DFO was described as turning a "blind eye" to the issue. It was felt that there should be more collaboration between DFO and the province to deal with this issue.

Saskatchewan, Manitoba and Ontario do not allow gravel removal from Canadian fisheries waters. Gravel is taken from available glacial till areas in Ontario. Gravel sources in Manitoba occur in designated Wildlife Management areas that were actually areas of land not sold to the private sector because the land was too gravelly.

Alberta does not have any appreciable research programs on impacts to the fishery resulting from gravel/aggregate removal. It is believed that relevant literature on impacts may exist in the U.S.A. The scope of the problem in Alberta needs to be determined because it was unclear to the group if it is specific and localized in Alberta, or common in other areas where such activities are taking place, especially in the United States. Alberta has guidelines that were last updated in 1986 and are currently under revision.

3.12.4 ACTIONS

The **top five actions** proposed by this group to address the list of barriers/gaps/opportunities were as follows:

GRAVEL REMOVAL

Rating	Action	No. of Votes
1	**Conduct literature review to find existing case studies, guidelines, policies. Information should be shared across jurisdictions.**	19
2	**Increase public awareness of issues and problems. Education of the public will build support for government initiatives to regulate activities with the goal of achieving NNL.**	14
3	**Promote/initiate research on impacts to fish and fish habitat.**	13
4	**Promote/conduct workshops with producers, developers, proponents, and regulators.**	10
5	**Increase involvement of Department of Fisheries and Oceans.**	3

Other suggested action items that received 2-3 votes were:

- Research to increase knowledge of the biology of all aquatic species that may be affected.
- Increase monitoring and enforcement.
- Increase resources to properly evaluate and manage the issue.

3.12.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

GRAVEL REMOVAL

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	60	37	3
Are the gaps important?	58	35	6
Do the actions have value?	47	44	9

FACILITATOR: Rick Sanden

RECORDER: Brent Valere

3.13 WILD RICE

3.13.1 BACKGROUND

BACKGROUND REPORT: WILD RICE AND ITS RELATIONSHIP TO FISH HABITAT

Prepared by:
Art Derksen
Fisheries Habitat
Fisheries Branch
Department of Natural Resources, Winnipeg

Introduction

Wild rice (Zizania spp) has been harvested by aboriginal North Americans for centuries. It has been staple food and an important trade commodity of native peoples. Commercial interest in wild rice began in the early 1900's, when restaurants in both the US and Canada included it as a gourmet item on their menus. Although wild rice was originally produced primarily in nature (lakes and rivers), this source was soon outstripped by wild rice produced in paddies. By 1985, paddy wild rice production, mostly from California and Minnesota, exceeded natural production by a ratio of 27:1 (Stewart et al. 1986). In the past two or three decades, wild rice has been introduced into areas in central Canada where it previously did not exist or its occurrence was rare. During this time, there has been a concerted effort by wild rice producers in the three Prairie Provinces and Northwestern Ontario to gain a greater share in the wild rice trade by advertising that their product comes from clean, unpolluted lakes and rivers of Canada. Along with this, there has been an aggressive expansion of the numbers of water bodies into which wild rice has been sown. During the past 20 years in particular, wild rice growers have extensively planted wild rice throughout the north central portions of Manitoba, Saskatchewan and Alberta, as well as in Northwestern Ontario.

In Manitoba, several hundred leases had been granted by the early 1990's and that number has grown since. Many of the original leases were taken out for water bodies in the area between The Pas and Flin Flon. The leasing of waters in this area was largely stimulated by the building of an extensive network of seasonal and all-weather forest access roads by the pulp mill located at The Pas. These roads make the waters much more easily accessible by the wild rice growers and consequently, make the production of wild rice much more profitable. The network of forest access roads is constantly expanding further northward and has begun to encroach on parts of the Churchill River. Wild rice leases have been taken out on waters in and around Kississing Lake, and as far north as the Burntwood River. (Several leases have also been let further north around the Churchill River in the Pukatawagan area.) Wild rice growing is also gaining momentum in the Thompson area; the pulp mill at The Pas is cutting and has developed an extensive road network in that area. In Saskatchewan, numerous wild rice permits have been issued for waters lying mostly between the 54th and 57th parallels, and some have been issued for waters as far north as

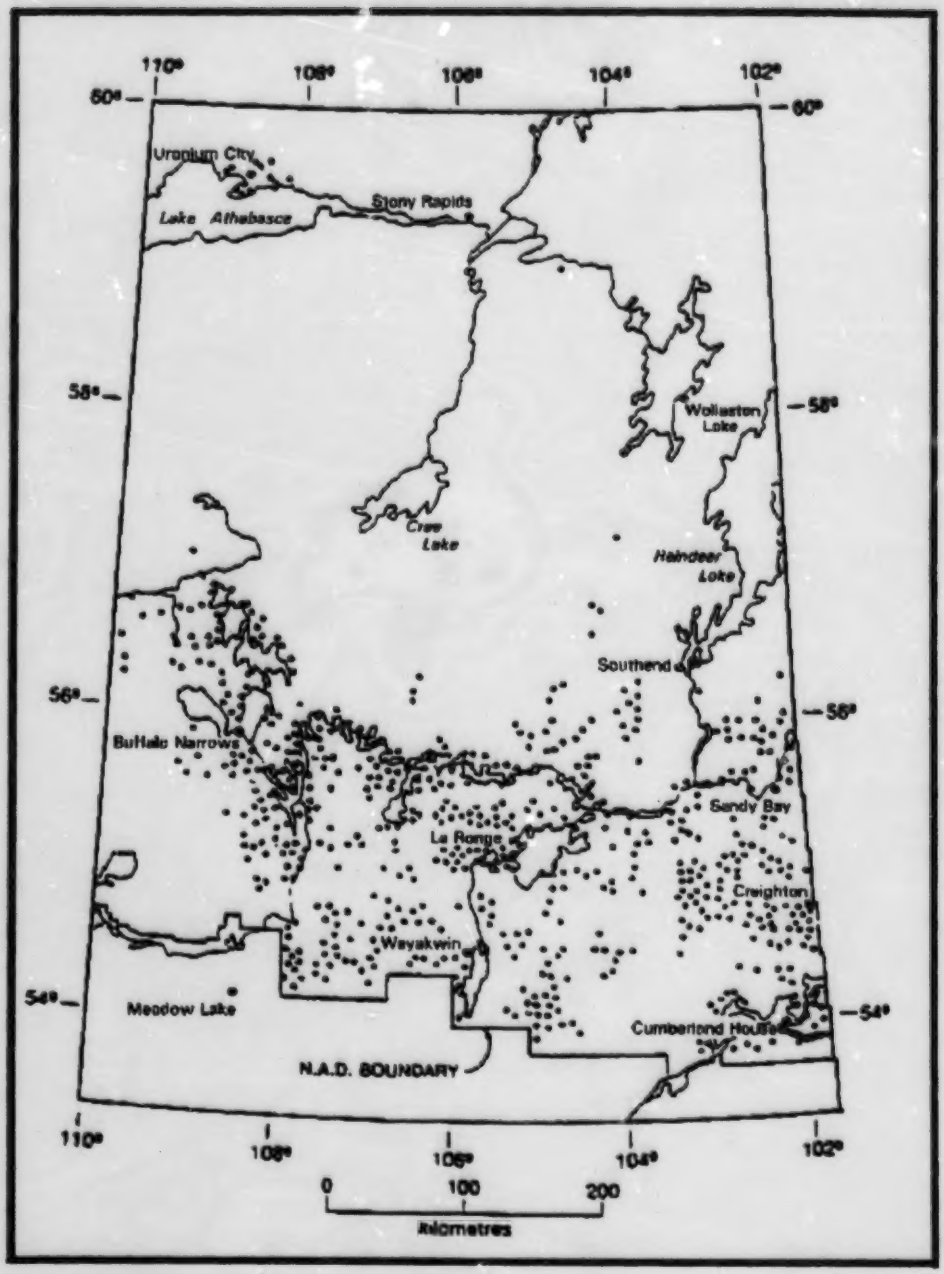

Figure 2. The distribution of wild rice permits in northern Saskatchewan (from Harvey, 1989).

Lake Athabasca, near the 60th parallel (Figure 2). It has been reported that there are approximately 200 wild rice leases in northern Alberta. It is not presently known to what degree the production of wild rice has been expanded in Northwestern Ontario.

Wild rice harvests (untreated or green seed) from Manitoba, Saskatchewan and Ontario for the period 1970-1988 area shown in Figure 3. Note that wild rice yields from Manitoba and Ontario tend to follow a three year cycle. These yields likely represent primarily the harvest of wild rice within its native distribution, especially for Manitoba. Wild rice has been harvested from southeastern Manitoba for many years. Wild rice was only introduced into north central Manitoba in the early 1980's and it was probably not until the latter part of that decade when stands were dense enough to harvest. The cyclical nature of the wild rice harvests may be related to the time required for the straw of the wild rice plant to completely decompose (Archibold 1991). Complete decomposition of the straw would provide additional nutrients for the new rice crop. It is interesting to note that the wild rice harvests from Saskatchewan do not exhibit any cyclical characteristics. Because of the scarcity of suitable waters in southern Saskatchewan , it is speculated that there was no production of wild rice from that province until it was introduced into the north central area in 1970 or earlier. The annual yields of wild rice from Saskatchewan show a gradual build-up to the point where they are similar to those of Manitoba and Ontario. More recent harvest statistics for Saskatchewan would likely show onset of the three year harvest cycle.

The statistics on wild rice harvests provided above presents the status of wild rice growing in Prairie Provinces up to about a decade ago. It is believed that there has been a considerable expansion in the planting of wild rice into new lakes and streams, particularly in Manitoba, in the decade since then. The expansion of wild rice growing in Manitoba, as noted above, has been aided by the expansion of the forestry road network in The Pas-Flin Flon and Thompson areas. Not only have more waters been seeded to wild rice, but those areas that have been planted are likely now beginning to become choked with wild rice. As wild rice grows in the shallower or littoral areas of lakes, and in streams, which are generally the most productive habitats of fish, it comes into direct competition with fish. The impact of wild rice on fish resources in the Prairie Provinces and Northwestern Ontario is believed to have reached a critical stage that requires immediate attention.

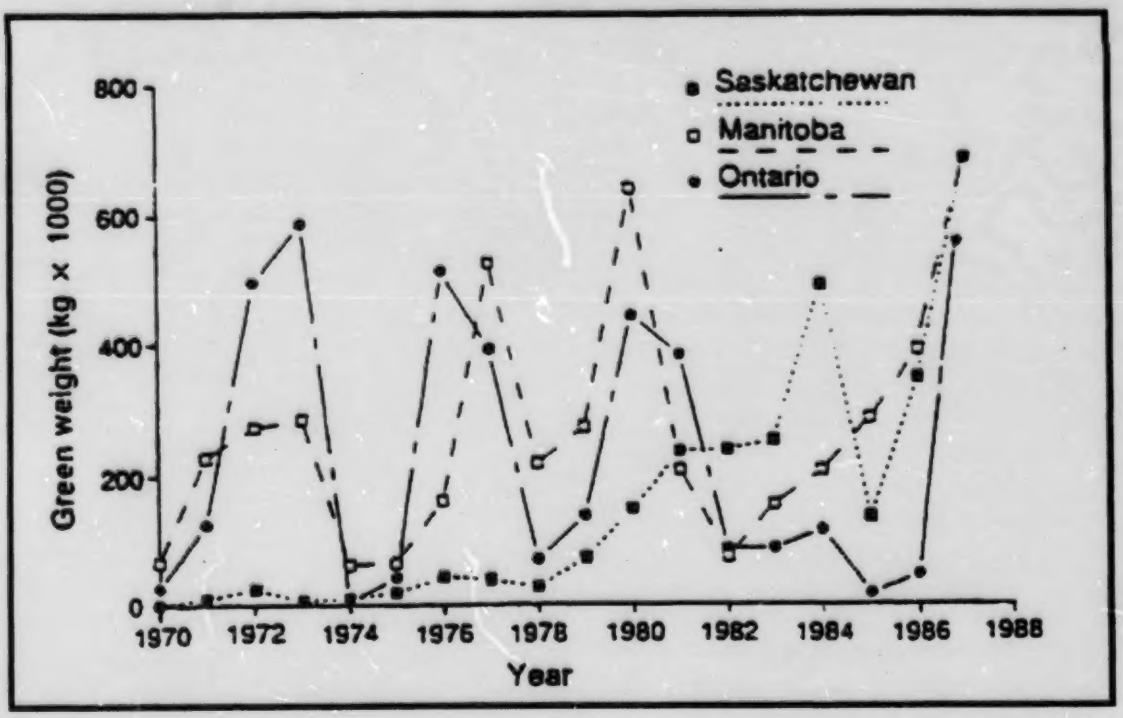

Figure 3. Cyclical fluctuations in production of long established wild rice stands in Ontario and Manitoba. Continued expansion of the industry in Saskatchewan has masked this effect until recently (from Harvey, 1989).

Implications to Fish Resources

Based on observations and experience with wild rice in The Pas-Flin Flon area of Manitoba, the following is a brief resume of the types of problems wild rice imposes on fish resources. These problems may be grouped into three broad categories of impacts; biological or environmental, economic, and social.

A. Biological/environmental impacts

As has been observed on lakes in the Flin Flon area, after about 10 years following initial seeding, wild rice can attain very dense stands. Entire bays of lakes have been filled with wild rice. In one lake, wild rice takes up as much as 10% of the lake's surface area. Wild rice will also grow in water depths of 2m or more. In very dense stands, no other aquatic plants may be seen; wild rice appears to crowd out other aquatic plants. The wild rice also appeared to exclude any significant algal production; the stems of a number of wild rice plants were examined and were devoid of any attached algae or periphyton. The stands also appeared to be devoid of any other aquatic life forms such as minnows or insects; not even surface insects such as hemipterans were

present. In contrast to this, a small lake that was choked with various species of submergent aquatic plants was teeming with a variety of minnows.

In areas which have supported dense stands of wild rice for some time, a significant build-up of wild rice straw is observed along the shorelines. The straw also accumulates on the bottom of the water body. As noted above, the complete decomposition of wild rice straw takes about 3 years. However, since straw is produced each year, the decomposition process is a continual one which occurs year-round. The decay of straw at the bottom of the lake during the summer would consume oxygen and render the substrates unsuitable for most benthic organisms. During the winters, the decay process would consume oxygen from the water column and create winterkill situations. Straw accumulations within streams and along the inshore areas of lakes may eventually lead to the obliteration of gravely or rocky areas that are utilized by fish as spawning areas. It has been observed that wild rice is well adapted to growing in flowing waters and, in Manitoba, a number of streams have become choked with wild rice. Dense stands of aquatic vegetation may have appreciable effects on water movement. Large rainfall events in the late summer or early autumn, when the wild rice crops have reached their maximum growth and density, might have a significant effect on the speed with which the runoff occurs and cause significant flooding.

The growing of wild rice in lakes and streams in an area where it never occurred before obviously represents a significant departure from the natural aquatic ecosystem processes. The devotion of water bodies, in whole or in part, may represent significant changes in energy pathways or nutrient cycling, in benthic invertebrate and fish communities and their inter-relationships, in the surrounding aquatic birds and mammals, and in the ultimate fate of the water body. Over a prolonged period of time the water bodies may become so enriched that plant succession is accelerated.

B. Economic Impacts

Wild rice has effected the economics of commercial fisheries in Manitoba in several ways. Lake areas that have been overtaken by rice are no longer available to commercial fishermen. Firstly, the dense stands of rice make it virtually impossible to travel by outboard motor boat, the principal conveyance used by commercial net fishermen. Secondly, it is impossible to fish with gill nets in waters where wild rice is growing. Thirdly, the shallower portions of many lakes, where commercial fishermen used to set their nets for large pike, no longer produce large pike. Fourthly, the enhanced winterkill conditions created by wild rice may have reduced the winter catches on lakes where significant areas of those lakes have been taken over by wild rice. Commercial bait fishermen have also lost to wild rice some of the lakes that they fished for bait minnows. Finally, there has been at least one instance where degraded water quality, which was the direct result of wild rice, effected the winter operation of a commercial fish packing plant.

Wild rice may also be impacting the economics of the sport fishery. Lakes and streams that have become filled with wild rice are no longer suitable for angling. Remote areas that were once accessed by anglers by canoe or small boat are no longer used because of the difficulty in traveling through the dense wild rice stands. Complaints are being heard from non-resident, as well as

resident anglers, and may well be impacting tourism in the area. Wild rice may also limit the expansion of tourist fishing lodge development in some areas around the larger lakes.

C. Social Impacts

Wild rice growing in Manitoba has posed some problems with the allocation of resources and has the potential to create further resource allocation problems in the future. Some of the existing allocation conflicts have been outlined briefly above; i.e. the problems of commercial sport and bait fishermen in areas that have been devoted to wild rice. Wild rice growers will want to maintain road access to their wild rice lakes to provide for the economical harvesting and transporting of the rice. Similarly, rice growers will want to maintain field camps for accommodating works and storing harvesting equipment. This may lead to future conflicts with the allocation of other resources such as fisheries (private fish camps), wildlife (private hunting camps) and recreation (cottages), as well as with native land claims and resource-use areas.

Literature Cited

Archibold, O.W. 1991. Straw residues in wild rice (Zizania palustris L.) stands in northern Saskatchewan. Can. J. Plant Sci. 71: 337-345.

Harvey, B.L. 1989. Untitled report on wild rice. In O.W. Archibold (ed.). Wild Rice Research in Saskatchewan, Final Report. Saskatchewan Agriculture and University of Saskatchewan, Dept. Crop Science.

Stewart, J.M.D. Punter and B. Lamothe. 1986. A review of the wild rice industry in Manitoba: 1986. Dept. of Botany, University of Manitoba, and Manitoba Department of Natural Resources. 72 pp.

Mr. Ken Crutchfield provided the following additional notes about wild rice in Alberta:

- There are approximately 90 disposition holders in Alberta from a high of approximately 120 six years ago.
- Disposition holders are limited to 5 water bodies per disposition.
- Approximately 1-2 people per year enquire about wild rice from a high of 8-9 six years ago.
- Fish and Wildlife Management Division has established a set of criteria to guide acceptance of wild rice dispositions.
- Majority of current dispositions are located in east-central Alberta (Edmonton east).
- Interest appears to have waned in Alberta. There were a considerable number of dispositions that previously failed to establish wild rice.

Two "Straw Man" objectives were provided for the Wild Rice breakout group:

1. Determine impacts of wild rice on aquatic environments.
2. Interim measures to prevent further habitat alteration until impacts are better understood.

3.13.2 LIST OF OBJECTIVES

The breakout group provided the following **three objectives:**

1. **Determine the positive and negative impacts of introduced wild rice on aquatic ecosystem especially with respect to fish habitat.**
2. **Produce an interim science-based set of guidelines to regulate the industry until more information is gathered to ensure No Net Loss (NNL).**
3. **Establish networking with other resource management sectors / resource users with interest in the issue (Wildlife Management, Parks management, Ducks Unlimited, trappers, hunters, sport fishery and commercial fishery).**

There were many interesting points and observations brought up in this session; these included:

- Increases noted in the First Nations wild rice production in Saskatchewan and Manitoba.
- Some priority given in leases to natives.
- Economic issue - crop of wild rice worth more than fish value.
- Horticultural aspects of plant is well understood.
- Uncontrolled "experimental" seeding has resulted in significant numbers of introductions with no follow-up or future evaluations.
- Considerable study done on environmental requirements for wild rice to succeed, but little resources have been expended on assessment of impacts.
- As more experience is gained some initial "facts" are changing: i.e., grows in marsh areas; spreads on its own; inhabits deeper water areas (up to 6 - 7 feet depth).
- Wild rice appears to displace native macrophytes when it becomes established.
- The unknown aspects of the impacts are of greatest concern.
- There is no question that loss of habitat occurs during mid-summer (pre-harvest) and winter (anoxic conditions).
- Some experience from Saskatchewan shows that walleye fishery can co-exist (15 years of experience) well with wild rice. Impacts appear more neutral.
- Boat passage routes are required to be kept cleared, however navigation regulations have never become an issue.
- Other disciplines, particularly wildlife, have now begun to express some concern.
- Straw man objective # 1 is clearly a priority with the understanding that it is based on introduced wild rice and not naturally occurring wild rice as in some Ontario cases.
- Straw man objective #2 as stated is likely not realistic. The industry may be too well established to expect curtailment or a moratorium. It would be more appropriate to

regulate introductions through guidelines until a determination of NNL can be made.

- A suggested objective: Develop liason/support from other disciplines/users for more studies.

3.13.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five barriers/gaps/opportunities** with respect to addressing the objectives (Numbers in parenthesis represent the number of votes):

1. **Lack of research on wild rice as it relates to aquatic ecosystems. (18)**
2. **Lack of knowledge on its distribution and effects on fish habitat. (10)**
3. **Lack of policy on multiple use of lakes and streams. (10)**
4. **Lack of comprehensive ecosystem management objectives. (9)**
5. **Regulatory/jurisdictional conflicts and contradictions e.g., one section of government is promoting development while another department is expressing a lack of knowledge.(4)**

Other barriers/gaps/opportunities identified during discussions included:

- Lack of resources.
- Need for networking and information sharing.
- Link wild rice impacts with cumulative impacts of forestry harvesting as many wild rice leases/expansion projects follow the road development.
- Lack of planning and absence of major principals relative to land and water use.

3.13.4 ACTIONS

Although limited by time, the group formulated the **top five actions** as follows (Number of votes were not recorded):

WILD RICE

Rating	Action	No. of Votes
1	**Promote more site specific research and documentation of case studies to improve our knowledge on impacts on fish habitat.**	n.r.
2	**Scope the extent of wild rice introductions and determine the limits of its spread from the introduction site.**	n.r.
3	**Raise profile of this issue with government agencies and public.**	n.r.
4	**Include wild rice development/licencing under cumulative impact issues requiring Environmental Assessment.**	n.r.
5	**Open up public dialogue on extent of acceptable expansion of industry.**	n.r.

n.r. = not recorded

3.13.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

WILD RICE

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	78	19	3
Are the gaps important?	87	13	0
Do the actions have value?	87	13	0

FACILITATOR: Art Derksen

RECORDER: Bruce Wright

3.14 BIODIVERSITY

3.14.1 BACKGROUND

Canada has signed and ratified the United Nations Convention on Biological Diversity, and has committed to promoting the conservation of biodiversity and to the sustainable use of biological resources. All provincial and territorial governments share this responsibility, along with private organizations.

Protection of fish habitat is an integral part of maintaining a healthy ecosystem and preserving aquatic biodiversity. While humans have benefited greatly from aquatic ecosystems, they have not always used these resources with care and respect. Commercial exploitation of aquatic organisms, introduced species, contaminants and loss of habitat have resulted in significant reductions in population size of many fish species and degrading genetic diversity.

The big challenge is to understand the intricate relationship between fish habitat and aquatic biodiversity and develop appropriate framework and management measures.

"Straw Man" Objectives:

1. An appropriate framework for management of aquatic biodiversity.
2. Agreed benchmark against which compliance for biodiversity conservation can be measured.
3. Improved integration between terrestrial and aquatic biodiversity efforts.

3.14.2 LIST OF OBJECTIVES

The breakout group formulated the following **five objectives**:

1. **An appropriate framework for the management of aquatic biodiversity.**
2. **Increase recognition of need for aquatic biodiversity management at the manager and policy maker level.**
3. **Clarify responsibility of fish habitat managers. What is the relative role of federal or provincial agencies and of fisheries and environmental agencies?**
4. **Clarify linkage of biodiversity to fish habitat decisions.**
5. **Clarify whether biodiversity is a consideration of habitat transfer decisions.**

The biodiversity topic brought out the philosophical and pragmatic views within the group. Some opinions indicated that biodiversity must be addressed by habitat managers. Others noted that habitat management agencies in reality are focusing on a narrower view, that of fish habitat in aquatic systems whereas others, such as parkland management agencies, are more focused on the terrestrial aspects of biodiversity and less on the aquatic. Is the aquatic environment then, simply one component of biodiversity? What federal or provincial agency really manages biodiversity? We seem to be managing specific things that are all part of the biodiversity concept.

While formulating the list of objectives, the following items were discussed as well:

- Can we equate habitat management to biodiversity management?
- The biodiversity of an aquatic system should not imply one benchmark because simple and complex aquatic systems exist.
- What is the role of biodiversity in legislation (*Fisheries Act*) and policy?
- Is the *Fisheries Act* used to protect only one aspect of biodiversity?
- We need basic tools and information for assessing aquatic biodiversity.
- Does biodiversity imply preserving a system that is adapted to its environment?

4.14.3 BARRIERS/GAPS/OPPORTUNITIES

The group provided the following list as their choice of **top five gaps** (#5 and #6 were tied) with respect to addressing the objectives (Number in parenthesis represent the number of votes):

1. **Clarify the biodiversity objectives of resource management agencies. (18)**
   - Is one assuming that the other is covering biodiversity with the result that biodiversity is in reality neglected?
2. **Framework to connect biodiversity to regulatory decisions. (11)**
3. **Lack of clear policy. (11)**
4. **Clarify each agency's biodiversity responsibility. (11)**
5. **Research to connect fish habitat aspects to biodiversity elements. (8)**
6. **A practical definition of biodiversity as applied to fish habitat i.e., instead of an encyclopaediac production, we need a handbook or fish habitat manager's guide to biodiversity. (8)**

Other gaps that were recorded during the discussions included:

- Tools to recognize unique and valued components of ecosystems.
- Public lack of knowledge of diversity within species.
- Lack of knowledge on how much diversity is out there.
- Are our activities threatening biodiversity?
- Lack of knowledge on the impact of introductions and invasions on biodiversity.
- Clarification of compensation requirements - does an agency request a "complex" or a "single species" habitat?

3.14.4 ACTIONS

Discussion on actions began with the thought of specifically incorporating biodiversity into the policy or whether biodiversity may be in conflict with the policy depending on interpretations. The unclear role of different agencies in addressing biodiversity was the next major discussion topic. In the end, the group generated a short list of **top four actions** for which voting was unnecessary.

BIODIVERSITY

Rating	Action	No. of Votes
1	**Incorporate biodiversity guidelines into DFO habitat policy or directives.**	-
2	**Develop decision guidelines for applying biodiversity under federal and provincial policy.**	-
3	**Inventory legislation and policies of fisheries and environment agencies to discover biodiversity requirements.**	-
4	**Meeting of interagency leaders to establish who is covering what - how big are the holes in the sieve?**	-

3.14.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

BIODIVERSITY

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	75	13	13
Are the gaps important?	70	21	9
Do the actions have value?	58	32	10

FACILITATOR: Bill McMillan

RECORDER: Wayne Hyatt

3.15 HABITAT TRANSFER

3.15.1 BACKGROUND

Some projects affecting fish habitat can be sufficiently large that habitat types or class can be greatly changed or modified. These types of projects or undertakings are usually on a grand scale such that habitat is transferred or converted to a completely different regime.

Examples of these types of projects could include thermal or nuclear power plants where whole lakes are transferred from a cold water system supporting trout and whitefish to a warm water system more suitable for centrarchids and percids. These changes are usually attributed to cooling water being discharged directly to receiving bodies of water.

Similar activities on a smaller scale such as in-stream ponds or impoundments can have warming effects on small streams and rivers. The change of fluvial habitats to lacustrine systems can result in major changes to fish habitat conditions and result in changes to fish species assemblages.

With these types of major habitat changes or transfers, it is very difficult to assess what if any habitat compensation can be acceptable.

"Straw Man" Objectives:

1. Specific means to assess the mitigation and/or compensation required for habitat transfer situations.
2. Shared list of mitigation approaches and compensation requests.
3. Agreed to guidelines for use in decisions about potential habitat transfers related to proposed projects.

3.15.2 LIST OF OBJECTIVES

Discussion time for this session was limited.

The facilitator indicated that the group, having just completed a long session on biodiversity, proposed that objectives for habitat tranfer would fit within the objectives framework of biodiversity (Section 3.14.2)

3.15.3 BARRIERS/GAPS/OPPORTUNITIES

The top **five gaps** formulated by the group were as follows (Numbers in parenthesis represent the number of votes):

1. **National inventory of compensation agreements and monitoring. (14)**
2. **Greater collaboration with proponents to initiate study, monitoring and maintenance**

activities. (11)
3. **Clarify what follow-up work/study is needed and who does it. (11)**
4. **Clarify units of conversion for replacement of previous fishery. (9)**
5. **Lack of analysis of previous habitat transfer projects that did not work. (9).**

A major discussion centered on stakeholder perception of habitat transfer/replacement versus scientific defensible criteria. In the end, it seems that the habitat manager is thrust into the role of a scientist by providing a measurement of the habitat gained or lost as a result of the proposed habitat transfer activity.

Other discussion items included:

- Clarify whether single species substitution is acceptable.
- Research: What is the role of the habitat and how do fish use it?
- Concern: habitat transfer could be guesswork and success/failures may not be fully documented.
- Opportunity: follow-up studies on whole lake production.
- Clarify criteria for habitat/production replacement.

3.15.4 ACTIONS

The group did not have time to formulate a list of actions.

3.15.5 PLENARY REVIEW OF RECOMMENDATIONS

Results of the electronic voting by plenary session participants on the above recommendations were as follows:

HABITAT TRANSFER

	% Agree	% Agree with Conditions	% Disagree
Do you agree with the objectives?	-	-	-
Are the gaps important?	72	28	0
Do the actions have value?	-	-	-

FACILITATOR: Bill McMillan

RECORDER: Barrie Corbett

4.0 SUMMARY OF RECOMMENDATIONS AND SUPPORT

4.1 RECOMMENDATIONS AND MEASURING SUPPORT

Breakout discussion groups were assigned to provide, for each workshop topic, a list of recommendations according to three **categories**:

1. Objectives,
2. Gaps/Barriers/ Opportunities (abbreviated terminology: "Gaps"), and
3. Actions.

At the end of each plenary presentation, workshop participants were asked to indicate their relative **support** or **approval** for each category by voting for one of three choices:

1. Agree,
2. Agree with Conditions (i.e., partial agreement) or
3. Disagree.

The results of the electronic voting for each topic reflected a variety of opinions among participants as the plenary sessions progressed (Section 3.1.5; 3.2.5; 3.3.5;.....to 3.15.5). To gain a better view of the support for the entire workshop recommendations, the relative support displayed by participants for the sets of recommendations (i.e., recommendation categories) for the 15 topics are summarized in Table 3.

Table 3. Summary of support shown by workshop participants for the Objectives, Gaps (Gaps/Barriers/Opportunities) and Actions presented in the plenary sessions.

A dash (-) indicate that the breakout discussion group had provided no list.

1. APPLYING NO NET LOSS QUANTITATIVELY

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	90	10	0
Are the **gaps** important?	80	17	3
Do the **actions** have value?	80	20	0

2. WHOLE LAKE DESTRUCTION

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	68	32	0
Are the **gaps** important?	63	33	3
Do the **actions** have value?	71	18	11

3. CUMULATIVE EFFECTS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	72	28	0
Are the **gaps** important?	77	23	0
Do the **actions** have value?	67	33	0

4. REGIONAL SCALE PROJECTS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	-	-	-
Are the **gaps** important?	82	18	0
Do the **actions** have value?	-	-	-

5. TIMBER HARVESTING IMPACTS ON WATERSHEDS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	55	33	12
Are the **gaps** important?	45	39	16
Do the **actions** have value?	48	42	9

6. INSTREAM FLOW NEEDS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	63	38	0
Are the **gaps** important?	70	24	6
Do the **actions** have value?	70	24	6

7. HYDRO PEAKING

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	61	30	9
Are the **gaps** important?	58	39	3
Do the **actions** have value?	56	44	0

Table 3, continued

8. AGRICULTURE TRENDS AND ANTICIPATED IMPACTS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	81	19	0
Are the **gaps** important?	72	25	3
Do the **actions** have value?	75	22	3

9. CHANNELIZATION

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	69	25	6
Are the **gaps** important?	88	6	6
Do the **actions** have value?	88	13	0

10. ROAD CROSSINGS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	69	31	0
Are the **gaps** important?	84	13	3
Do the **actions** have value?	74	23	3

11. PIPELINE CROSSINGS

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	69	22	9
Are the **gaps** important?	59	38	3
Do the **actions** have value?	57	43	0

12. GRAVEL REMOVAL

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	60	37	3
Are the **gaps** important?	58	35	6
Do the **actions** have value?	47	44	9

13. WILD RICE

	Agree (%)	Agree with Conditions (%)	Disagree(%)
Do you agree with the **objectives**?	78	19	3
Are the **gaps** important?	87	13	0
Do the **actions** have value?	87	13	0

14. BIODIVERSITY

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	75	13	13
Are the **gaps** important?	70	21	9
Do the **actions** have value?	58	32	10

15. HABITAT TRANSFER

	Agree (%)	Agree with Conditions (%)	Disagree (%)
Do you agree with the **objectives**?	-	-	-
Are the **gaps** important?	72	28	0
Do the **actions** have value?	-	-	-

4.2 LEVEL OF SUPPORT.

4.2.1 General Support for Objectives, Gaps and Actions per Topic

A closer examination of the data in the agreement column ("Agree") for all three recommendation categories in each topic (Table 3) provided one way of evaluating the support for that topic by workshop participants. It became obvious that the level of support shown by the larger group of workshop participants (N = 65 to 70 persons) for several categories of recommendations differed from the presumed high consensus reached by the smaller breakout groups (N = 15 to 18 persons) during the formulation of their lists. A good example was the Biodiversity topic where agreement with the objectives and gaps identified were 75 percent and 70 percent, respectively; however, agreement on the actions proposed gathered noticeably lower support (58 percent). In contrast, a consistent high level of support for the three categories occurred for the No Net Loss topic where 90, 80 and 80 percent agreement were recorded.

No Net Loss was also a good example of a topic that obtained high overall support (80-90 percent) for all three categories. In contrast, Timber Harvesting Impacts on Watersheds obtained a relatively low overall support (55, 45 and 48 percent).

Table 3 also shows that there was no instance of unanimous support for any category (Agree=100 percent). Whenever workshop participants decided not to vote for full agreement, their choice was primarily for partial agreement ("Agree With Conditions) rather than total disagreement ("Disagree").

Inspection of all data in the "Disagree" column (Table 3) show that the highest disagree score attained for any category was 16 percent. The majority of the results registered in this category were low values, ranging from 0 to 9 percent. The next level of disagreement, ranging from 10 to 16 percent, was recorded in 1 or 2 categories in Whole Lake Destruction (Actions), Timber Harvesting Impacts on Watersheds (Objectives; Gaps), and Biodiversity (Objectives; Actions). There was no instance of unanimous disapproval (Disagree=100 percent).

Table 4 is a further summary examining only the support data recorded (i.e., percent agree data) for all the recommendation categories for the 15 workshop topics. The topics are also listed in order of overall perceived support determined by the average value for each topic's three recommendation categories. The top three topics with high level of support were Wild Rice, No Net Loss and Channelization. The bottom three on the list were Hydro Peaking, Gravel Removal, and Timber Harvesting. There were insufficient data to rate Regional Scale Projects and Habitat Transfer in relation to other 13 topics.

Table 4. List of workshop topics and the level of support registered by workshop participants for each topic's three recommendation categories.

WORKSHOP TOPIC	RECOMMENDATION CATEGORIES AND LEVEL OF SUPPORT (Percent Agree)			AVERAGE (Percent Agree)
	OBJECTIVES	GAPS/BARRIERS/ OPPORTUNITIES	ACTIONS	
1. Wild Rice	78	87	87	84.0
2. Applying No Net Loss Quantitatively	90	80	80	83.3
3. Channelization	69	88	88	81.7
4. Agricultural Trends and Impacts	81	72	75	76.0
5. Road Crossings	69	84	74	75.7
6. Cumulative Effects	72	77	67	72.0
7. Instream Flow Needs	63	70	70	67.7
8. Biodiversity	75	70	58	67.7
9. Whole Lake Destruction	68	63	71	67.3
10. Pipeline Crossings	69	59	57	61.7
11. Hydro Peaking	61	58	56	58.3
12. Gravel Removal	60	58	47	55.0
13. Timber Harvesting Impacts	55	45	48	49.3
14. Regional Scale Projects	-	82	-	*
15. Habitat Transfer	-	72	-	*

\- No list produced

* Insufficient Data

4.2.2 Support for full set of Objectives, Gaps, and Actions across all Topics

Because of the diversified level of support for categories within some topics, the data in Table 3 or 4 can be examined in another way by looking at only one category at a time (Objectives; Gaps; Actions) for all topics. The purpose is to identify those categories among all 15 topics that obtained a high, medium and low level of support. For the purpose of this section, the levels of support are defined arbitrarily as follows:

- High level of support: 70 to 90 percent agreement.
- Medium level of support: 50 to 69 percent agreement.
- Low level of support: ≤ 49 percent agreement.

Support for List of Objectives:

Table 5 is a summary of the level of support (or approval) obtained for the list of **objectives** for 13 workshop topics. The Objectives for five topics received a high level while nine received medium approval. There was no instance of a low level of support (≤49 percent agreement) i.e., when at least half the voters disagreed with the objectives.

Support for List of Gaps:

Table 6 shows that for the 15 individual lists of **gaps** presented, a high level of support was obtained for ten workshop topics while the gaps for four topics registered a medium level. The list of gaps for Timber Harvesting Impacts on Watersheds was the only one that obtained a low level of approval (Agree=45%).

Support for List of Actions:

Table 7 shows that for the 13 individual lists of **actions** presented, a high level of support was obtained for seven topics while four registered a medium level. The actions for two topics (Timber Harvesting Impacts on Watersheds and Gravel Removal) obtained low approval levels of 48 percent and 47 percent, respectively.

There was little time available during the plenary sessions to allow a closer look at instances where a low level of support was identified; therefore, the tentative opinions or conditions that influenced participants who voted "Agree with Conditions" or "Disagree" for certain recommendation categories remain undefined. The apparent lack of consensus on some issues was to be expected from such a diverse group of people. The perception of plenary participants with respect to the relative importance among the 15 topics could have been influenced by concerns and priorities in the face of impending development scenarios within an individual's home province. Such regional bias may have exerted some influence during the plenary voting process where participants were perhaps evaluating breakout session data with a broader scope that encompassed issues from several topics being presented in one long session.

The distribution of the electronic voting pads added another element of variability. These voting pads were not available for every workshop participant because only 53 keypads were set up. Consequently, the votes registered for each voting event represented only an average sample of N=50 (range: 47-52 ; Bill McMillan, personal communication) drawn from the 60-70 participants in the plenary sessions. In addition, given the predominance of DFO personnel at the workshop and that no specific effort was made to pro rate the distribution of these pads among federal and provincial participants, one can speculate that voting results may at times have reflected some agency bias.

Table 5. Summary of the level of support obtained for the list of Objectives for 13 workshop topics (Individual scores are in parentheses).

HIGH	MEDIUM	LOW
• Applying No Net Loss Quantitatively (90%) • Agricultural Trends and Anticipated Impacts (81%) • Wild Rice (78%) • Biodiversity (75%) • Cumulative Effects (72%)	• Channelization (69%) • Road Crossings (69%) • Pipeline Crossings (69%) • Whole Lake Destruction (68%) • Instream Flow Needs (63%) • Hydro Peaking (61%) • Gravel Removal (60%) • Timber Harvesting Impacts on Watersheds (55%)	None

Table 6. Summary of the level of support obtained for the list of Gaps for 15 workshop topics (Individual scores are in parentheses).

HIGH	MEDIUM	LOW
• Channelization (88%) • Wild Rice (87%) • Road Crossings (84%) • Regional Scale Projects (82%) • Applying No Net Loss Quantitatively (80%) • Cumulative Effects (77%) • Habitat Transfer (72%) • Agricultural Trends and Anticipated Impacts (72%) • Instream Flow Needs (70%) • Biodiversity (70%)	• Whole Lake Destruction (63%) • Pipeline Crossings (59%) • Hydro Peaking (58%) • Gravel Removal (58%)	• Timber Harvesting Impacts on Watersheds (45%)

Table 7. Summary of the level of support obtained for the list of Actions for 13 workshop topics (Individual scores are in parentheses).

HIGH	MEDIUM	LOW
• Channelization (88%) • Wild Rice (87%) • Applying No Net Loss Quantitatively (80%) • Agricultural Trends and Anticipated Impacts (75%) • Road Crossings (74%) • Whole Lake Destruction (71%) • Instream Flow Needs (70%)	• Cumulative Effects (67%) • Biodiversity (58%) • Pipeline Crossings (57%) • Hydro Peaking (56%)	• Timber Harvesting Impacts on Watersheds (48%) • Gravel Removal (47%)

5.0 WORKSHOP RECOMMENDATIONS – THE NEXT STEP

Workshop participants will receive the workshop report and its recommendations. All jurisdictions may use the recommendations for reference purposes. In addition, there will be an ongoing steering process to continue cooperative efforts and ensure that the workshop recommendations are addressed. There is a commitment by members of the existing Working Group to provide the ongoing steering process. They will pick up the priorities that emerge from this June 1998 workshop and coordinate roles, responsibilities and action. While this activity may require an endorsement from senior management of each constituency, the great value in collaborating is recognized by all.

It may appear that an initial task for the Working Group is to focus on the categories of recommendations that elicited a low level of approval (Tables 5, 6 and 7) from plenary participants; the data seem to represent possible contentious issues that need to be examined first. This report did not examine the reasons why some participants disagreed or had reservations in agreeing fully with certain breakout recommendations. As mentioned previously, the workshop's tight schedule to accommodate the numerous breakout presentations in each day's plenary session limited the time allowed to pursue thorough discussion of any conflicting perceptions or opinions.

We must recall, however, that each breakout session involved a specially selected grouping of federal and provincial people who were asked to focus only on two related topics in isolation. As a result, each breakout group's list of recommendations per topic must be considered appropriate and valid because their session results reflected the collective thoughts and ideas from this opportunistic gathering of provincial and federal fish managers, biologists and engineers. This was the primary design and goal of the workshop and the results should be an important focus of future Working Group discussions.

In its new coordinating role, the Working Group might stay in place for several years after the workshop. Similarly, this group can coordinate priorities with other committees such as the one currently working on the Prairie Provinces Science Agreement. The ultimate goal is to have senior provincial and federal managers continue to work towards implementing regional fish habitat management programs in a cooperative and consistent manner.

6.0 WORKSHOP EVALUATION

6.1 GUIDING PRINCIPLES FOR FISH HABITAT MANAGEMENT

Workshop participants were given a questionaire with a list of fourteen "Guiding Principles for Fish Habitat Management." that had been presented at the start of the workshop as "straw man" principles in a workshop handout (see Appendix D). With the plethora of ideas, issues and actions over the past three days still fresh in their minds, participants were asked to grade the importance of each guiding principle on a scale of 1 to 5 (1=strongly disagree; 3=neutral opinion; 5=strongly agree). The results are shown in Table 8 where the group's rating of guiding principles (mean score) is listed in descending order.

The top five principles obtained a mean score ranging from 4.8 to 4.1:

1. **Shared Research**. (mean score = 4.8),
2. **Natural Reproduction**: Tied for first place (mean score = 4.8).
3. **Cooperative Approaches**: (mean score = 4.7)
4. **HADD1**: (mean score = 4.4).
5. **No Cumulative Loss**; **Biodiversity**; **No Net Loss**; **HADD 2**: These four principles tied for 5th place (mean score=4.1).

Ranked in last place (mean score = 3.2) was the principle stating the desire to achieve a **Net Gain**) of productive capacity of fish habitats as a result of all human activities impinging on Canada's fish habitats and its fishery resource.

Table. 8. Results of a poll on "Guiding Principles for Fish Habitat Management" taken from participants at the Prairie Habitat Management Workshop, June 3 to 5, 1998. (Scale from 1 to 5, where 1=Strongly Disagree, 2=Neutral Opinion, 3=Strongly Agree).

GUIDING PRINCIPLES FOR FISH HABITAT MANAGEMENT	Mean
SHARED RESEARCH: Share research and information and co-ordinate the implementation and documentation of basic and applied research supporting fish habitat management	4.8
NATURAL REPRODUCTION: Fish populations are to be maintained by natural reproduction wherever possible	4.8
COOPERATIVE APPROACHES: Share guidelines, assessment tools, and requirements regionally and nationally wherever practical	4.7
HADD 1: Prevent, wherever possible, the harmful alteration, disruption or destruction of fish habitat	4.4
NO CUMULATIVE LOSS: Cumulative fish habitat loss caused by numerous projects or activities within a region must be avoided	4.1
BIODIVERSITY: Biological diversity of fish is to be maintained, and the depletion of extirpation or species, populations, sub-populations or unique strains is to be avoided	4.1
NO NET LOSS: Ensure no net loss of productive capacity of fish habitats occurs as a result of human activities	4.1
HADD 2: Where HADD is unavoidable, ensure that appropriate mitigation measures are applied and adequate compensation is obtained	4.1
PUBLIC CONSULTATION: The public should be informed and consulted about major or controversial fish habitat issues, policies and legislation	4.0
SCIENCE: Use scientifically defensible methods for assessing impacts on fish habitat	3.9
SCIENCE BASED DECISIONS: Use science-based decision making for all activities affecting the productivity of fish habitats	3.9
PUBLIC ACCESS: Public access to waters producing publicly owned fish must be provided and maintained	3.7
SUSTAINABLE MANAGEMENT: Site-specific and regional net gains of fish habitat productivity must be consistent with sustainable management of Canada's aquatic resources	3.6
NET GAIN: Achieve a net gain of productive capacity of fish habitats as a result of all human activities impinging on Canada's fish habitats and hence its fishery resources	3.2

6.2 GENERAL EVALUATION

The workshop facilitator provided an evaluation form that listed eight workshop evaluation categories. Participants were asked to fill out the form by grading each of the eight categories on a scale of 1 to 5 (1= Very Unsatisfied; 5=Satisfied). The results are shown in Table 9.

Table 9. Frequency of evaluation scores, percent distribution of scores, and mean score for eight workshop evaluation categories. (Scale from 1 to 5, where 1=Very Unsatisfied, 3=Neutral Opinion; 5=Satisfied).

EVALUATION CATEGORY	N	Score					Mean Score
		1	2	3	4	5	
Effort to build a foundation for future co-operation	51	-	-	6	21	24	4.4
	%	-	-	12	41	47	
Quality of technical presentations	52	-	1	4	18	29	4.4
	%	-	2	8	34	56	
Location of meeting	52	-	3	5	10	34	4.3
	%	-	6	10	19	65	
Opportunity to exchange ideas	51	-	1	5	22	23	4.3
	%	-	2	10	43	45	
Advance information about workshop	51	-	1	9	19	22	4.2
	%	-	2	18	37	43	
Range of topics	52	-	4	7	15	26	4.2
	%	-	8	13	29	50	
Quality of workshops	52	-	1	6	33	12	4.1
	%	-	2	12	63	23	
Quality of plenary discussions	49	-	1	20	23	5	3.7
	%	-	2	41	47	10	

6.3 SUMMARY OF SPECIFIC COMMENTS

Plenary Session:

Participants rated most evaluation categories of the workshop as satisfactory (mean score $\geq$4.1) except for "Quality of Plenary Sessions" which scored a mean of 3.7, brought on mainly by the high proportion of individual scores of 3.0. Coincidentally, most of the written comments dealt with the inadequacies of the plenary session. Plenary sessions were described as "too long" and "at times lacked adequate discussion time after each presentation was given." There was an obvious need for more feedback from the workshop participants especially on weak or soft responses to some plenary presentations. One participant indicated that it was difficult to take everything in and make a knowledgeable decision so fast with little information and discussion. This perception would explain why the workshop facilitator, on several occasions, was unsuccessful in soliciting more discussions from the floor. Workshop planners were aware of the strict time restrictions and, in retrospect, the time given to the plenary session was small in relation to time given to accommodate the numerous breakout sessions. The tight schedule and the requirement to accommodate eight presentations in each 90 minute plenary session contributed to a feeling of "information overload" for some workshop participants.

Workshop Topics:

There were no specific comments on the choice of workshop topics. Some participants, however, felt that there were too many topics for the two days of sessions. It seemed that some individual topics could warrant a one-day workshop by themselves, never mind sixteen topics in two days.

Free Time:

There were comments promoting the need for more free time during the workshop. Some people felt that a tremendous amount of benefit could have been achieved if the workshop schedule had incorporated more free time for mingling, networking and idea exchange. It is assumed, however, that most participants appreciated the Organizing Committee's intention to facilitate these situations by scheduling the workshop at the remote hotel and conference facilities at Gull Harbour Resort at Hecla, Manitoba.

The workshop evaluation and the comments provided do not diminish the benefits obtained from the Prairie Fish Habitat Management Workshop. The mix of participants per breakout session promoted an exchange of information, perceptions and experiences which facilitated identification of many common elements as well as problem areas in fish and fish habitat management. The list of **Objectives**, **Barriers/Gaps/Opportunities**, and **Actions** for each topic provided what Habitat Managers have been urgently seeking, i.e., What are the common challenges that will require collaborative effort to solve? What aspects seem to require immediate attention? All these will be taken into consideration in planning the future course in fish habitat management in Alberta, Saskatchewan, Manitoba and Ontario.

APPENDIX A. ORGANIZING COMMITTEE

DEPARTMENT OF FISHERIES AND OCEANS MEMBERS

Ed DeBruyn, Habitat Management Division, Burlington
Kathy Fisher, Habitat Management Division , Winnipeg
Garry Linsey, Habitat Management Division, Winnipeg
Charles K. Minns, Great Lakes Laboratory for Fisheries and Aquatic Science, Burlington.
Jeff N. Stein, Habitat Management Division, Winnipeg

PROVINCIAL MEMBERS

Ken Crutchfield, Alberta Environmental Protection, Edmonton
Gareth Goodchild, Ontario Ministry of Natural Resources, Peterborough
Maynard Chen, Saskatchewan Environment and Resource Management, Regina
Lori Thompson , Manitoba Natural Resources, Winnipeg

WORKSHOP FACILITATOR

Bill McMillan, Equus Consulting Group, Edmonton

APPENDIX B. LIST OF PARTICIPANTS

DEPARTMENT OF FISHERIES AND OCEANS

Drew Bodaly, Winnipeg, Manitoba
Bill Bond, Belleville, Ontario
Karen Broughton, Winnipeg, Manitoba
Karen Calla, Vancouver, British Columbia
Elaine Carlow, Winnipeg, Manitoba
Ken Chang-Kue, Winnipeg, Manitoba
Doug Chiperzak, Yellowknife, NWT
Don Cobb, Winnipeg, Manitoba
Dana Cruickshank, Sault Ste. Marie, Ontario
Julie Dahl, Yellowknife, NWT
Rick Erickson, Winnipeg, Manitoba
Bruce Fallis, Winnipeg, Manitoba
Ray Finn, St John's, Newfoundland
Kathy Fisher, Winnipeg, Manitoba
Bill Franzin, Winnipeg, Manitoba
Bob Fudge, Winnipeg, Manitoba
Karen Gray, Burlington, Ontario
Daniel Hardy, Mont-Joli, Quebec
Fred Hnytka, Winnipeg, Manitoba
Glen Hopky, Ottawa, Ontario
Wayne Hyatt, Burlington, Ontario
Earl Jessop, Winnipeg, Manitoba
Chris Katopodis, Winnipeg, Manitoba
Marg Keast, Iqaluit, Nunavut
Karen Kidd, Winnipeg, Manitoba
Shelly Luce, Burlington, Ontario
Dorothy Majewski, Winnipeg, Manitoba
Henry Majewski, Winnipeg, Manitoba
Karen Ralph, Burlington, Ontario
Bob Randall, Burlington, Ontario
Michelle Roberge, St John's, Newfoundland
Alex Salki, Winnipeg, Manitoba
Karen Smokorowski, Sault Ste. Marie, Ontario
Rob Stevens, Ottawa, Ontario
Christine Stoneman, Burlington, Ontario
Beth Thompson, Winnipeg, Manitoba
Brent Valere, Burlington, Ontario

ALBERTA (Alberta Environmental Protection)

Vance Buchwald, Red Deer
Dave Christiansen, Rocky Mountain
Ken Crutchfield, Edmonton
Allan Locke, Edmonton
Trevor Rhodes, Strathmore
Dave Walty, Peace River

ONTARIO (Ontario Ministry of Natural Resources)

Bruce Adamson, Thunder Bay
Raymond Biette, Toronto
Barrie Corbett, Kenora
Gereth Goodchild, Peterborough
Steve McGovern, South Porcupine
Neville Ward, Kenora

MANITOBA (Manitoba Natural Resources)

Art Derksen, Winnipeg
Joel Hunt, Winnipeg
Richard Janusz, Winnipeg
Keith Kristofferson, Lac du Bonnet
Doug Leroux, The Pas
Lori Thompson, Winnipeg
Bruce Wright, Brandon

SASKATCHEWAN (Saskatchewan Environment and Resource Management)

John Durbin, Prince Albert
Jennifer Merkowsky, Saskatoon
Kevin Murphy, Regina
Rick Orr, Regina
Rick Sanden, Regina
John Weir, Meadow Lake

QUEBEC

Stephanie Lachance, Ministere de l'Environment et de la Faune, Quebec

YUKON

Clive Osborne, Department of Renewable Resources, Whitehorse

APPENDIX C. WORKSHOP AGENDA

AGENDA
PRAIRIE FISH HABITAT MANAGEMENT WORKSHOP
GULL HARBOUR RESORT, MANITOBA
JUNE 3-5, 1998

WEDNESDAY, JUNE 3:

1600-1800	Workshop Registration
1700-1800	Happy Hour
1800-1900	Icebreaker Dinner
1900-1915	Introductory Remarks, Workshop Agenda and Objectives - Bill McMillan
1915-1925	Alberta Overview - Ken Crutchfield
1925-1935	Saskatchewan Overview - Rick Orr
1935-1945	Manitoba Overview - Lori Thompson
1945-1955	Ontario Overview - Gareth Goodchild
1955-2005	DFO Habitat Management Overview - Garry Linsey
2005-2015	DFO Science Overview - Ken Minns
2015-2030	Open Discussion
2030-2130	Summary of Common Issues/Concerns - Bill McMillan

THURSDAY, JUNE 4:

0800-0830	Workshop Overview - Bill McMillan
0830-0900	Technical Presentation - Defensible Methods for No Net Loss - Ken Minns
0900-1215	Breakout Session I

THURSDAY, JUNE 4 (Cont'd):

1215-1330	Lunch
1330-1400	Technical Presentation - IFM, The Alberta Method - Alan Locke
1400-1530	Plenary for Breakout Session I
1530-1545	Refreshment Break
1545-1615	Technical Presentation – Lake 226 Drawdown Ezperiment at ELA -Drew Bodaly
1615-1630	Closing Plenary
1800-1900	Dinner
1900-2000	Technical Presentation – Sediment Control – Bruce Adamson

FRIDAY, JUNE 5:

0800-1130	Breakout Session 2
1130-1200	Technical Presentation – Fish Screening Techniques – Chris Katopodis
1200-1300	Lunch
1300-1420	Plenary for Breakout Session 2
1420-1500	Open Discussion Workshop Evaluation

APPENDIX D. GUIDING PRINCIPLES FOR FISH HABITAT MANAGEMENT

The working group noted the need for a common foundation among the workshop participants as a basis for discussion.

The following principles are sent to you as "Straw Man" principles (i.e. you are encouraged to add, delete or change as you wish). On June3, we will have a discussion about the principles and other elements of common ground. It may be important that we reach agreement about a common set of principles that can be used by participants in the breakout sessions.

"**Straw Man" Principles** (2nd ed.; 3 June 1998)

Outcomes already embedded in legislation or policy:

1. **No Net Loss**: Ensure no net loss of productive capacity of fish habitats occurs as a result of human activities. [DFO policy].
2. **Net gain**: Achieve a net gain of productive capacity of fish habitats as a result of all human activities impinging on Canada's fish habitats and hence its fishery resources. [DFO Policy].
    - *Questions: What is required to make this concept measurable? What does "productive capacity" include?*
3. **HADD 1**: Prevent, wherever possible, the harmful alteration, disruption or destruction of fish habitat. [Section 35(1)].
4. **HADD 2**: Where HADD is unavoidable, ensure that appropriate mitigation measures are applied and adequate compensation is obtained. [Section 35(2)].

Other outcomes:

5. **Sustainable Management**: Site-specific and regional net gains of fish habitat productivity must be consistent with sustainable management of Canada's aquatic resources.
6. **No Cumulative Loss**: Cumulative fish habitat loss caused by numerous projects or activities within a region must be avoided.
7. **Biodiversity**: Biological diversity of fish is to be maintained, and the depletion or extirpation of species, populations, sub-populations or unique strains is to be avoided.

Communication and decision making:

8. **Science-Based Decisions**: Use science-based decision making for all activities affecting the productivity of fish habitats.
9. **Public Consultation**: The public should be informed and consulted about major or controversial fish habitat issues, policies and legislation.

10. **Science**: Use scientifically defensible methods for assessing impacts on fish habitat.
    - Alternate: Fish habitat management will be conducted on the basis of accepted ecological principles and scientifically documented information.

11. **Cooperative Approaches**: Share guidelines, assessment tools, and requirements regionally and nationally wherever practical.
12. **Shared Research**: Share existing research findings and available information; it is also important to coordinate the implementation and documentation of basic and applied research supporting fish habitat management.

Habitat Management Guidelines:

13. **Public Access**: Public access to waters producing publicly owned fish must be provided and maintained.
14. **Natural Reproduction**: Fish populations are to be maintained by natural reproduction wherever possible.

APPENDIX E. MENU OF HABITAT MANAGEMENT TOOLS AND BREAKOUT SESSION GUIDELINES

Prairie Fish Habitat Management Workshop
June 3-5, 1998

Menu of Habitat Management Tools
(To be used by all groups as a discussion aid)

Research

Guidelines

Policy/Legislation

Knowledge Transfer (Regulators/Public)

Protocols (Assessment, Inventory)

Monitoring

Enforcement

Management Plans

Compensation

BREAKOUT SESSION GUIDELINES

About the Format:

At each of the breakout sessions, two topics have been grouped together. The intention of this grouping is to give more time for discussion and to gain efficiency by reducing the amount of time dedicated to room changing and group building. It is expected that many of the discussion groups will find that some aspects of their first topic discussion will carry over to their second topic as well.

The Intended Outcome:

In the breakout sessions, the discussion groups will be identifying a number of recommendations to be brought back to plenary for information. In the plenary sessions, people will be asked to indicate their level of support for those recommendations. The most important recommendations to bring forward on each topic are:

- Common objectives.
- The most important gaps between the current situation and the ideal.
- The most important actions needed (see workshop objectives).

How to Prepare:

In each breakout session, "straw man" objectives have been proposed. Feel free to reword these objectives before you get to Gull Harbour (your counter-proposals are valued... the words provided are just to stimulate your thinking). Ask two other colleagues what they think are the biggest problems and opportunities affecting the topics you are addressing. If you want to bring examples of projects, policies or studies that could benefit the group, please do... but bring about 24 copies so that everyone can get one.

The Breakout Session Process

Topic 1: Take Approximately 90 Minutes

1. Introductions and Overview of Process (10 min.)
2. Setting Common Objectives (25 min.)
   - Start with a list of proposed objectives on the wall in front of you.
   - Add, delete, or change as you like.
   - "Vote" for or against each objective. Any objective must get at least 75% support (i.e., 9/12, 10/13, 11/14, 12/15, 12/16, 13/17, 13/18, 14/19, 15/20, etc.) to be accepted as a "common" objective. Don't sweat the precise wording ... worry instead about the intention that is being described.
3. Identify Gaps: Opportunities and Barriers (30 min.)
   - Identify "opportunities" and "barriers" that currently describe the gap between where we are and where we would like to be.
   - When the group has identified a list of both the opportunities and the barriers, you will be given an opportunity to pick the top five gaps (using both lists) that you would like to see addressed.

4. Identify Actions (25 min.)

   - Identify the actions that would make the greatest difference in achieving greater coordination, efficiency, and effectiveness in achieving the objectives on the wall in front of you. Address the most important gaps first.

   - Your group will select the five most important actions to report to the plenary (don't worry ... the other ideas will also be recorded).

Topic 2:

Same discussion format as Topic 1, but the time required will be shorter since you have already been through the introduction and you have already discussed some ideas that will be relevant to this topic.

REFRESHMENT BREAK [AT ANY TIME]

APPENDIX F. TECHNICAL PRESENTATIONS - EXTENDED ABSTRACTS

F.1 DEFENSIBLE METHODS OF ASSESSING FISH HABITATS

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Effective implementation of Canada's Policy for the Management of Fish Habitat ('No Net Loss') requires quantitative tools for assessing net gain or loss of productive capacity of fish habitat. As measurement of fish productivity is difficult and expensive, surrogate measures, primarily physical habitat, must be used to assess the potential impact of development activities on fish habitat productivity. Beginning with Great Lakes' nearshore habitats, a quantitative suitability model for lacustrine habitats has been developed using aggregate measures of fish preference for various depth ranges, and substrate and cover types. Habitat preference databases have been assembled by life stage (spawning, nursery, and adult) for all Great Lakes fishes and incorporated in a Microsoft Access database. Habitat suitability values are computed using the database. A Windows based software program ("Defensible Methods") enables users to input pre- and post-development scenarios of areal fish habitat supply by depth, substrate, and cover types, and computes fish suitability-weighted usable areas. Summations of weighted suitable area, the product of area and suitability, across habitat units affected by proposed development provide a measure of net change of fish habitat productivity. The approach has been developed and tested using several habitat projects selected by the DFO FHM group in Ontario. The features of the approach and software are illustrated using a simple case study. The approach can be validated using standardized field fish and fish habitat surveys. Further developments of Defensible Methods currently under way will:

1. Extend the requirements database coverage of lacustrine habitats to other regions of Canada.
2. Expand the scope to include stream habitat beginning with southern Ontario.

Plans are being prepared to market Defensible Methods via the Internet. The approach followed in the development of this assessment tool has been iterative and adaptive. Much of the success of this project is attributable to the collaboration and feedback from fish habitat management staff in various agencies and the fishery/environmental consultants representing proponents of development activities impinging on fish habitats.

F.2 INSTREAM FLOW NEEDS IN ALBERTA – THE GOOD, THE BAD, AND THE UGLY

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Instream Flow Needs (IFN) studies for the protection and management of fish have been conducted in Alberta by the Fish and Wildlife Management Division (FWMD) over the past 15 years. Methods have ranged from the simple, like the Tennant, and the Tessman modification of the Tennant, to the more complex, such as the Instream Flow Incremental Methodology (IFIM) using the PHABSIM group of models. The recommended flow values that are derived from these studies are used as input in basin wide water planning exercises. Water planning is conducted using a water balance model that requires input from all water users. On the consumptive side, there are municipal water supply demands and irrigation demands for agriculture. On the non-consumptive side, there are fish and wildlife management needs, recreation and, where present, hydropower generation. Requested instream flow values were originally limited to a "minimum" value, which were considered to protect basic water quality and instream flow needs at all times. Later in the water planning process, an "optimal" or preferred value was requested in addition to the minimum. It was believed the preferred value would protect desirable instream flow needs most of the time. While the single input value was convenient for the running of the water balance model, it gave the false impression that if this minimum value was met, the fisheries resources would be adequately protected. As this is not the case, it was necessary to provide to the water balance modeling process, a range of values, from minimum to optimal, in order to effectively manage the fisheries resource. The purpose of this presentation is to describe the procedure that was used to take the principal output from the PHABSIM group of models, Weighted Usable Area (WUA) versus discharge, and convey that information into a range of recommended flow values that are linked to the naturally occurring availability of water in a river system. Following the water planning process, the negotiated IFN values become restrictions placed on new water consumption licenses issued pursuant to the *Water Resources Act* (Alberta). In Alberta, we continue to look at new methods for protecting instream values. A study was recently carried out on the Kananaskis River where a two-dimensional hydraulic model was used. As well, radio-telemetry data was used to develop habitat suitability indices for the target management species, brown trout.

F.3 THE LAKE 226 DRAWDOWN EXPERIMENT AT THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO.

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This presentation will summarize recent results from the Lake 226 drawdown experiment and will also briefly mention other ongoing and potential habitat disturbance research at the ELA.

The purpose of the Lake 226 drawdown experiment is to investigate the effects of winter drawdown, simulating the water level regimes in northern hydroelectric reservoirs. Water levels in Lake 226 were drawn down by 2-3 meters during three years; summer levels have varied from 0.7-1.5 m below natural levels. The water column of the lake changed little due to drawdown, despite predictions of decreased light penetration and increased nutrients due to resuspension of bottom sediments. The littoral zone, in contrast, has been severely affected by drawdown, especially with respect to benthic algal populations, aquatic macrophytes, and benthic invertebrates. Lake whitefish spawning locations were determined by acoustic tagging combined with substrate classification using GIS. Whitefish were spawning on cobble substrate in shallow areas affected by drawdown and they suffered year class failures due to drawdown. The experiment is now in a recovery phase and future work could include the evaluation of different water level regimes or artificial spawning beds.

F.4 EROSION AND SEDIMENT CONTROL FOR THE PROTECTION OF FISH HABITAT IN NORTHERN ONTARIO

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Abstract

For over ten years, the Ontario Ministry of Natural Resources (OMNR) has worked with developers to protect fish habitat, while allowing in-stream construction projects to proceed. A marked improvement has been achieved in design and construction practices to reduce erosion and sediment on construction sites in water. The techniques used include guidelines, training, permit reviews, on-site discussion and Fisheries Act charges. The onus is placed on the builder to achieve end-result standards (e.g., stable non-eroding site at end of construction; no blockage of migration routes). An understanding of on-site activities and their impacts on fish is encouraged. The idea is to anticipate events and plan for them.

For most water crossings, the builder chooses the methods of achieving the standards. Where a high risk to fish or fish habitat exists, sediment control plans are used to focus attention on site-specific practices to be followed. The regulator has an opportunity to review and approve these plans to make sure the best available practices will be used. In some cases habitat changes are authorized by the Department of Fisheries and Oceans (DFO), with compensation. The effort has been successful to date; however, recent staff reductions at OMNR will make continuing competency a new challenge. The presentation will use slides to illustrate both off-land and in-stream erosion control. Case studies will be presented concerning Ontario's forest industry and the gas pipeline industry.

Introduction

The Ontario Ministry of Natural Resources (OMNR) is a provincial government department whose mandate is the management of Ontario's public lands and waters. About 90 percent of Northern Ontario is public Crown land. OMNR also manages most of the province's natural resources, such as forests, parks, fish and wildlife.

Approximately 15 percent of Northern Ontario's surface area is water containing fish. Healthy fish populations are important to the economy, to the ecology and to the quality of life enjoyed by the people. Unfortunately, the heavily populated areas of Southern Ontario have experienced 200 years of development with little regard for fish and the habitat they live in. Streams have been channelized and lined with concrete, riparian zones along the water's edge have been

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changed, dams have been built on fish migration routes, pollution is discharged into the water from farms, streets and factories and sediment has destroyed fish spawning areas.

Fortunately all is not lost, areas of undisturbed wilderness still exist. Northern Ontario is relatively undeveloped and renowned for its excellent fishing opportunities. Towns are far apart and development activities are primarily related to forestry, mining and utility corridors (highways, pipelines, hydro lines). The topography is dominated by the Precambrian Shield. Generally bedrock is overlain by shallow soils deposited during the last glaciation. This resulted in numerous lakes and swamps that provide natural depositional areas for suspended sediments. Clean waters support populations of many sport fish like walleye, lake trout, northern pike, brook trout and bass.

Although OMNR is concerned about minimizing the impacts of development on the entire aquatic ecosystem, fish are recognized as an indicator species. Fish respond to changes in their habitat and the scientific knowledge is available to understand the impacts. In a general sense, if fish habitat is protected and preserved, habitat for other aquatic plants and animals will be helped as well. Furthermore, a focus on fish is enforceable under legislation, the *Fisheries Act*, which makes it an offence to destroy, disrupt or harmfully alter fish habitat. Other species in the ecosystem are not protected in this manner.

An environmentalist may argue that no development should occur in or near water because it will alter fish habitat. On the other hand, a developer may see bureaucratic regulations as unnecessary impediments to progress causing delayed work and increased costs. Political realities require compromise between these two extremes. This is reflected in OMNR's mission statement which encourages "environmentally sustainable economic development". Erosion and sediment control planning is an essential factor in reaching a satisfactory result. Without this, a construction project can be a major threat to the habitat needed by fish to survive.

The approach described in this paper has been developed and implemented in Northern Ontario over the last 10 years. It is based on trying to anticipate what will happen during construction and using mitigation measures to control impacts within acceptable bounds. The strategy has reduced conflicts, costs and delays for both OMNR and developers.

Fish Habitat

Fishing has long been an important component of Northern Ontario's lifestyle. The sale of angling licenses alone contributes $44 million to the province each year. Indirect benefits to the tourism industry and quality of life for residents are much higher. The fishing activity is undertaken by local residents and outside tourists, primarily from the United States. Many Americans return year after year to remote lodges and outpost camps for a week's fishing. As harvest pressures increase, fish abundance and catch per unit effort declines. Management of the fish resource is done by OMNR, primarily through restrictions on harvest (e.g., fishing seasons, possession limits, slot sizes, catch & release promotion) and by the protection or enhancement of fish habitat.

Fish habitat is at risk from several activities associated with construction projects. In-water work changes substrate conditions at the location being worked on. Sediment disturbed on the streambed or eroded off-land during rainstorms can enter the water and be carried downstream.

Sediment can have lethal impacts on fish in several ways[2]

- Spawning beds for many species (eg walleye, whitefish, brook trout) consist of cobble or gravel substrate where the eggs fall into the interstitial spaces between stone particles. In these spaces the eggs are protected from predators while water flow ensures the exchange of gases needed for survival. Sediment can fill the spaces and reduce or destroy productivity at the site.

- Suspended sediment can harm incubating fish eggs and fry. Many fish eggs have an adhesive surface to which suspended sediment will attach and cause the egg to suffocate.

- Increased suspended sediment retards photosynthesis by algae and rooted aquatic plants by reducing sunlight penetration into the water. This reduces production of food for aquatic life.

- Suspended sediment can cause changes in fish feeding behaviour since prey is less visible.

- High levels of suspended sediment can cause fish mortality lasting for many days.

Other potential impacts of construction on fish habitat include blockage of migration routes by culverts and changes to the creek bottom within the crossing right of way. Fish migration at culverts has not been studied in Northern Ontario, however there is suspicion that current standards are insufficient to prevent perched culverts and high flow velocities. These issues are beyond the scope of this paper.

To control the impact of construction, OMNR and/or DFO enforces a policy that any development approved in Ontario must not result in a net loss of fish habitat. This is partly achieved by mitigating potential impacts through the use of effective erosion and sediment control techniques. If habitat will be destroyed, even after using the best mitigation measures, then compensation is required for habitat lost. It usually involves creation of artificial spawning beds by placing selected substrate material close to disturbed areas.

The definition of fish habitat is broad, it includes spawning, nursery, rearing, food supply and migration areas on which fish depend. All streams are important, no matter how small. Work in a creek to install a 900 mm (3 foot) diameter culvert will cause sediment to enter the water during construction. The sediment can be carried downstream to larger streams where fish habitat could be damaged.

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[2] Refer to "The Problem of Sediment in Water for Fish", Neville Ward, Technical Note TN-21, OMNR northwest Region, 1992.

Apart from concern over fish habitat, there are many other reasons why sediment should be contained on the construction site and not allowed to flow downstream. These include:

- sediment can adversely affect water supply systems, both potable and industrial
- visual appearance of the water can offend some people when they see discoloration
- contaminated sediments in the streambed can become mobilized and move off-site
- deposition areas create changes in channel morphology that could impact on bank erosion and navigation.

Principles Used in Regulation of Construction in Water

Minor projects, such as floating dock construction, must follow good practice guidelines but they do not require review or approval. Larger projects are screened to determine potential impact and permits are issued. Typical work requiring permits are; bridges, large culverts, docks, shore protection, dams and pipeline water crossings. A condition of approval requires the developer to use materials, construction practices, mitigation techniques and monitoring of operations at every water crossing in order to prevent the unauthorized harmful alteration, disruption or destruction of fish habitat or the impairment of water quality. OMNR has worked with industry to establish standards, guidelines and training programs to help achieve this objective.

It is expected that erosion and sediment must be under effective control at all times. This does not mean that no sediment can enter the water or move downstream, however it does mean the builder must minimize the impact by reasonable use of erosion and sediment control measures. Potential long term impacts must be eliminated by stream restoration and site stabilization to prevent chronic off-land erosion and sediment. It is recognized a short term impact is unavoidable, however most streams will recover as flow flushes the sediment downstream to natural settling areas (ponds or lakes). With a few exceptions, the adverse impacts of erosion and sediment can be avoided by good planning and control.

The onus is on the builder to meet the OMNR fish habitat protection objectives. This allows the builder the flexibility to choose the techniques and methods by which erosion and sediment will be controlled; however, the end result must be achieved. All in-water structures must be engineered to perform satisfactorily. For example culverts must be sized to pass design flood flows and they must be properly installed to avoid collapse.

It is recognized that OMNR has a responsibility to communicate its expectations. Builders must have access to technical details about commonly used measures known to work (eg silt fence, diversion berm, erosion blanket, etc). Most OMNR monitoring staff are not experts in erosion and sediment control and they do not direct the selection of mitigation techniques. However, they have the training and knowledge to recognize when control is lacking and that action must

be taken by the builders. OMNR engineers are available for consultations and site visits to help resolve disagreements.

OMNR has worked closely with industries involved in water crossings to achieve a "win-win" situation - affordable construction with no delays for the builder and protection of fish habitat with minimum government involvement for OMNR. Two case studies of this partnership approach are described below.

Construction timing windows are used to discourage in-water activities during the time of the year when fish are most sensitive to sediment. The "closed" window is the egg incubation and fry emergence stages in the fish's annual life cycle. For a particular water body the time of year depends on the fish species present. Some fish spawn their eggs in the fall and the fry do not emerge until spring. Other species spawn their eggs in the spring and the critical time is only 6 weeks long. Usually no construction is allowed in water during the "closed" timing window. However, if work cannot be rescheduled or if it is demonstrated that construction will not cause any sediment to move downstream, work may be allowed during the critical time. such projects require a site-specific sediment control plan[3], approved by OMNR.

Although each site is unique, for low-risk construction projects, where impacts are predictable and controllable, a generic approach is followed. The builder's site will staff select appropriate best management practices for a particular water crossing. Examples would be small bridges, culverts or dam and pump pipeline crossings. For projects where there is a high risk to fish habitat (e.g. bridge piers, dams, open water pipeline crossings, work upstream of a cobble spawning bed), or when the consequences of sediment are serious (e.g., closed season), site-specific sediment control plans[3] must be submitted by the builder to OMNR for approval. This way, the regulator has assurance that best practices are followed and they share in decisions that put fish habitat at risk.

There are usually three parties required to develop, approve and implement a sediment control plan - the owner (designer), the regulator and the contractor. Each has a specific role to play and each has to "buy-in" to the process. To deal with changing site conditions, the builder should have authority to modify the approved sediment control plan; however, any changes should result in an improvement to erosion and sediment control on the site.

When unauthorized damage occurs to fish habitat, an investigation and possible charges may follow if an infraction of the Fisheries Act occurred. The introduction of sediment into water is not enough to justify charges; the prosecutor must prove that habitat was harmfully altered, damaged or destroyed. Guidance is available in the legislation and in case law. The defendant often argues that habitat damage was not proven by the prosecutor or that the builder exercised "due diligence". A sediment control plan, approved by the regulator and followed by the builder, would make a good due diligence defense. When present standards were first introduced in the early 90's, a few charges were laid each year in Northern Ontario under the

[3] Refer to "Sediment Control Plans; Reducing Sediment Concerns at Water Crossings", B. Adamson and A. Harris, Technical Note TN-20, OMNR Northwest Region, 1992.

Fisheries Act as a result of construction projects harming fish habitat. Conviction can result in fines up to $500,000 and a jail term.

Best Management Practices

Best management practices (BMP's) for erosion and sediment control are used during construction. There are many BMP's to select from and builders tailor the selection to suit a particular construction site. Two competent individuals may select different BMP's, however both are focusing on the same objective - effective erosion and sediment control.

Managing erosion and sediment requires a risk management approach. What is the worst that can happen? What are the consequences if it did happen? What is the likelihood that it will happen? Part of the consequences may include damage to the fish resource, an appearance in court and habitat restoration. OMNR has found the following practices to be effective in achieving low-cost erosion and sediment control:

BMP's in planning and design

- Consider sediment control in all project stages, including conceptual design and when identifying alternative structure types. For example, a long single span bridge may be preferred over a multiple span alternative which requires in-water work to build a pier.

- Identify likely construction methods to complete the structure and identify erosion/sediment control issues that may arise.

- Consider how stream flow will be managed during construction. For example, in placing a culvert, will the pipe be installed in flowing water or will a temporary bypass channel be used? If it is a complex project or if there is high risk to fish habitat, provide bidding contractors with draft work staging sequences, including erosion/sediment control details at each stage.

- Design permanent, end-of-construction, erosion control techniques to ensure the area will be stable before equipment moves off-site

BMP's in construction administration

- Assign clear accountability for sediment control to named individuals (eg planning, monitoring, response to problems).

- Use contractors experienced with in-water work.

- Encourage meaningful contractor input to erosion/sediment control planning.

- Conduct "tailgate" training for all workers, including the reasons why erosion/sediment

control is important.

- Have contingency plans and extra materials on site or readily available on short notice.
- Delay work in wet weather, especially if the creek or river is at flood stage when in-water work is scheduled.
- Work in a continuous manner and install erosion controls early.
- Use regular inspection and maintenance procedures to ensure erosion/sediment control measures are working.

BMP's for stormwater erosion and sediment control

- Vegetation is nature's erosion control technique - protect it as long as possible. This includes the use of undisturbed vegetation buffers and limiting the areal extent of disturbance.
- Select mitigation techniques that will be effective for the particular type of erosion occurring (e.g. sheet, rill, gulley, channel).
- Divert flow away from exposed soil (diversion berms, interceptor ditches).
- Slow down flowing water to reduce erosion and allow sediment to settle close to its source (silt fences, straw bales).
- For larger drainage areas, direct flow into channels protected from erosion (channel sized for flow, channel lining, check dams, off-takes, energy dissipaters).
- Use coarse granular fill materials near water.
- Grade disturbed soils to a stable angle, then apply seed, fertilizer and mulch to encourage early revegetation. Mix in organic material if necessary. Vegetation will provide long term, self-perpetuating and flexible erosion control - it is the key component in site stabilization.
- Install soil coverings if immediate erosion control is required (erosion blankets, straw or woody debris mulch, cobbles, rip rap, gravel sheeting).

BMP's for in-water construction work

- Isolate work areas from flowing water. Techniques include silt fences fastened to posts,

floating silt curtains, temporary bypass channel dam and pumped flow, erosion resistant cofferdam, inflatable water bladders, steel sheetpile, etc.

- Work quickly and in a sustained manner to minimize the amount of time in-water.

- Choose materials placed in water so as to minimize sediment transport downstream. It is good practice to use materials coarser than existing streambed soils. Restored streambed substrate should use materials beneficial to fish (e.g., screened cobbles).

- Consider stream restoration techniques that create characteristics found in natural channels. This might involve matching pre-disturbance geometry and the creation of pools and riffles, sinuosity, shade, large woody debris and shrub vegetation on stream banks.

Case Study - Forest Road Water Crossings

Ontario's forest industry constructs over 500 culvert and bridge crossings each year. In 1988, the Environmental Guidelines for Access Roads and Water Crossings was published. Although written by OMNR, the draft text was reviewed and debated in a meaningful way with fisheries biologists and the forest industry to achieve practical solutions. The document summarizes the legislation, sets mandatory standards, provides good practice guidelines and gives technical details about mitigation techniques. To date over 10,000 copies of the guidelines have been distributed. Figure 4 is a diagram from the manual showing typical erosion and sediment control measures at a bridge on a forest road.

OMNR developed and delivered training programs to introduce the techniques to everyone involved, from foresters and equipment operators to OMNR conservation officers who take infractions to court. The popular one day "water crossing workshops" involve a morning classroom session followed by an afternoon field visit by school bus to visit good and poor examples. Classroom subjects include: legislation; approval requirements and OMNR expectations; introduction to fish habitat; elementary erosion and sediment control; poor practices in the past; and, good practices expected in future. The bus ride gives an opportunity for regulatory staff to talk with foremen and equipment operators on an informal basis.

A two-day advanced course is available on how to prepare a site-specific sediment control plan. The first day covers erosion and sediment control theory and mitigation techniques. Day one also includes a detailed look at actual sediment control plans and how things turned out during construction. The second day is a hands-on exercise to develop a plan in small groups (3-4 people). Several fictitious water crossing sites are found near the workshop location and participants visit the site assigned to their group.

Participants assess physical conditions, such as soil conditions, ground slopes, access to far shore, water width, water depth, water flow management alternatives, isolation possibilities, etc. Back in the classroom, each group prepares a plan and presents it. Participants not only learn by

doing their own plan, they also have a chance to see what other people came up with for the same site. This training has been well received by the several hundred practitioners who have attended.

The result of these initiatives has been a dramatic change in the way access roads are built, for the betterment of fish habitat. There was little increase in cost for the industry because doing it right the first time saves money in the long run. As the use of BMP's became accepted practice the learning curve ended and OMNR has been able to reduce the time it spends on review, training and monitoring.

Recent government-driven changes have reduced MNR approval efforts for stream crossings and political issues have disrupted the cooperative Federal-Provincial administration of the Fisheries Act. The Forest Industry no longer needs to get site specific approval of water crossing details and many important MNR standards have been discarded through Regulation changes. Compliance monitoring of road and water crossing construction will now be done by the industry themselves, with MNR only doing spot checks. MNR and industry are seeing a loss of competency as experienced people retire or move to other jobs. Slippage in performance is being observed on forest road crossings built under the new approach. Environmental groups are now making field inspections and reporting significant deviation from standards at water crossings.

Case Study - Pipeline Water Crossings

TransCanada PipeLines (TCPL) distributes natural gas from Alberta to markets in eastern Canada and the United States. From 1989-94 a new 1 067 mm (42") diameter line was installed and currently another is under construction right across Ontario, a distance of 1400 km. The installation of large diameter pipelines requires pipe placement in an open trench 3 m (10 feet) below streambed. This type of work is very disruptive and control over short term erosion and sediment transport presents administrative and technical challenges. OMNR and TCPL cooperated in the development of a process to ensure the impact on fish habitat is controlled while approval time and costs for the pipeline company are minimized.

Water crossings that can be done in the "dry" are preferred because the isolation of working equipment from flowing water reduces the risk of downstream sediment transport. Dry crossings are of two types: **creeks** where the streamflow is dammed and pumped around the work area; and, **crossings** where creek flow is passed through a pipe flume, under which the trench is dug. For dry crossings, generic sediment control plans were developed to incorporate expectations and best management practices to be followed by the builder. OMNR does not require site-specific submissions about sediment control for this type of crossing, just adherence to the generic plans.

Wet water crossings are those where the builder does trench excavation, pipe placement and backfill in open water. To be assured the risk to fish habitat is minimized as much as possible, OMNR requires a site-specific sediment control plan for each wet pipeline crossing. Guidelines

for the preparation of these plans have been agreed upon between TCPL and OMNR. The submission includes:

- streambed material gradation to the bottom of trench and a prediction of where sediment will deposit downstream,
- an assessment of fish habitat characteristics in the area downstream of the crossing,
- the gradation for backfill material - it is selected to minimize transport in the water column,
- a site-specific plan for short-term control of off-land erosion and sediment during construction,
- a site-specific plan detailing permanent erosion and sediment control measures,
- a scheduled target time for each in-water operation (trenching, placement, backfill),
- the construction strategy explaining how the contractor will do the work and proposed equipment, and
- the proposed stream substrate restoration strategy.

The plan is written jointly by TCPL and its contractor. Once the plan is approved by OMNR, the builder can proceed with construction and OMNR has a good understanding of likely impact on fish habitat and has accepted those impacts. During review, if work is expected to cause the destruction of fish habitat, DFO authorization is sought and compensation will be undertaken to comply with the no-net-loss policy. Figure 5 is a diagram illustrating typical erosion and sediment control measures used on pipeline crossings.

Since it was introduced in 1992, the process has been used successfully at several hundred pipeline water crossings without problems. Within Ontario, the approach has been adopted by all other gas pipeline companies. Outside Ontario, two major utilities use a similar approach in other Provinces and States where they construct pipelines.

Conclusions

The construction of projects in water, such as culverts, bridges, pipelines and dams, can be undertaken in a cost-efficient manner that respects the objective of protecting fish habitat. It requires cooperation between regulators and developers. Success depends on good communication, a good understanding of each other's interests, a common-sense practical approach and a trusting relationship that will result in both parties achieving their objectives.

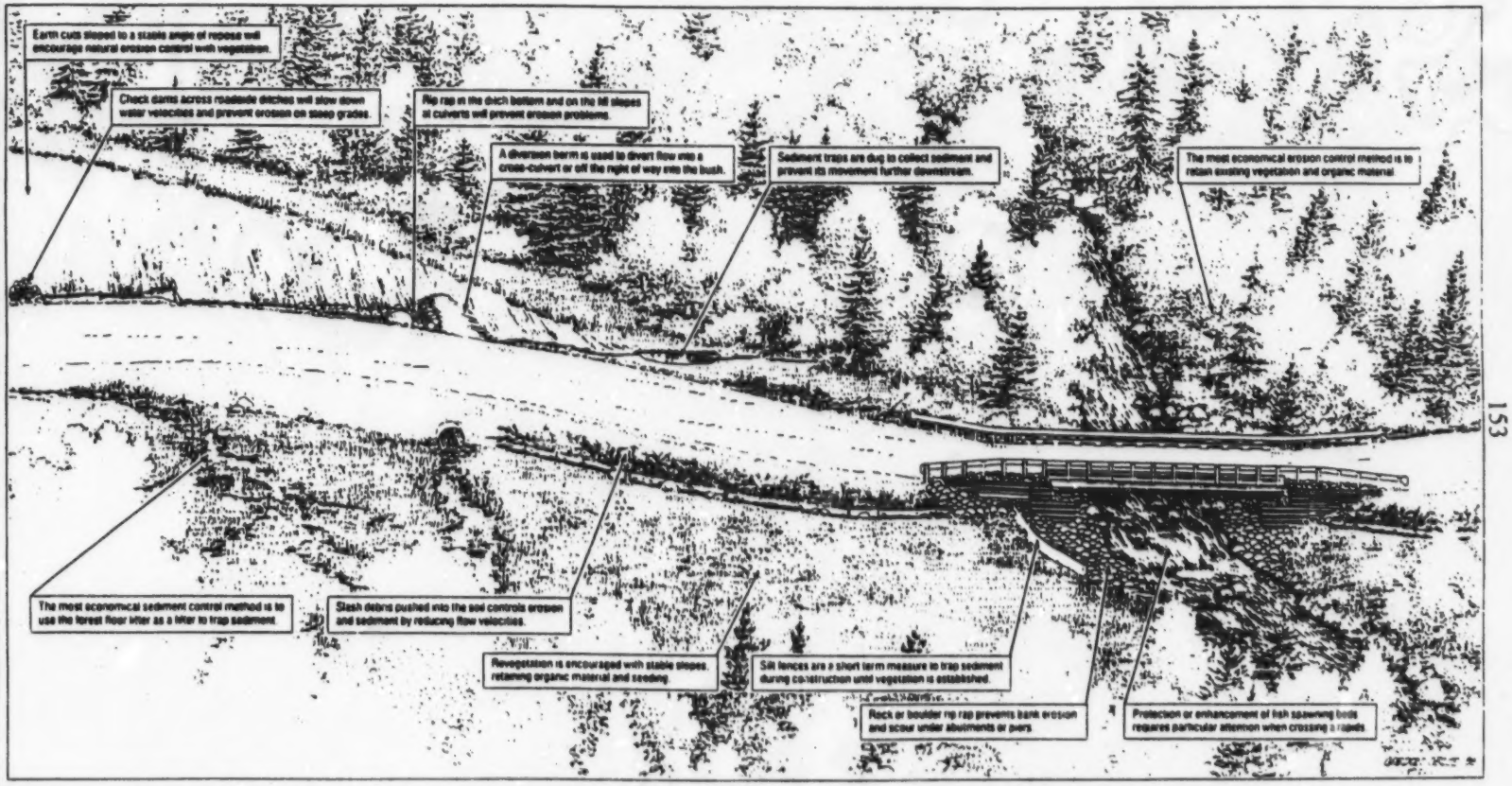
Reference Material

1 Environmental Guidelines for Access Roads and Water Crossings, OMNR, 1988.

2 The Problem of Sediment in Water For Fish, Neville Ward, Technical Note TN-21, OMNR Northwest Region, 1992.

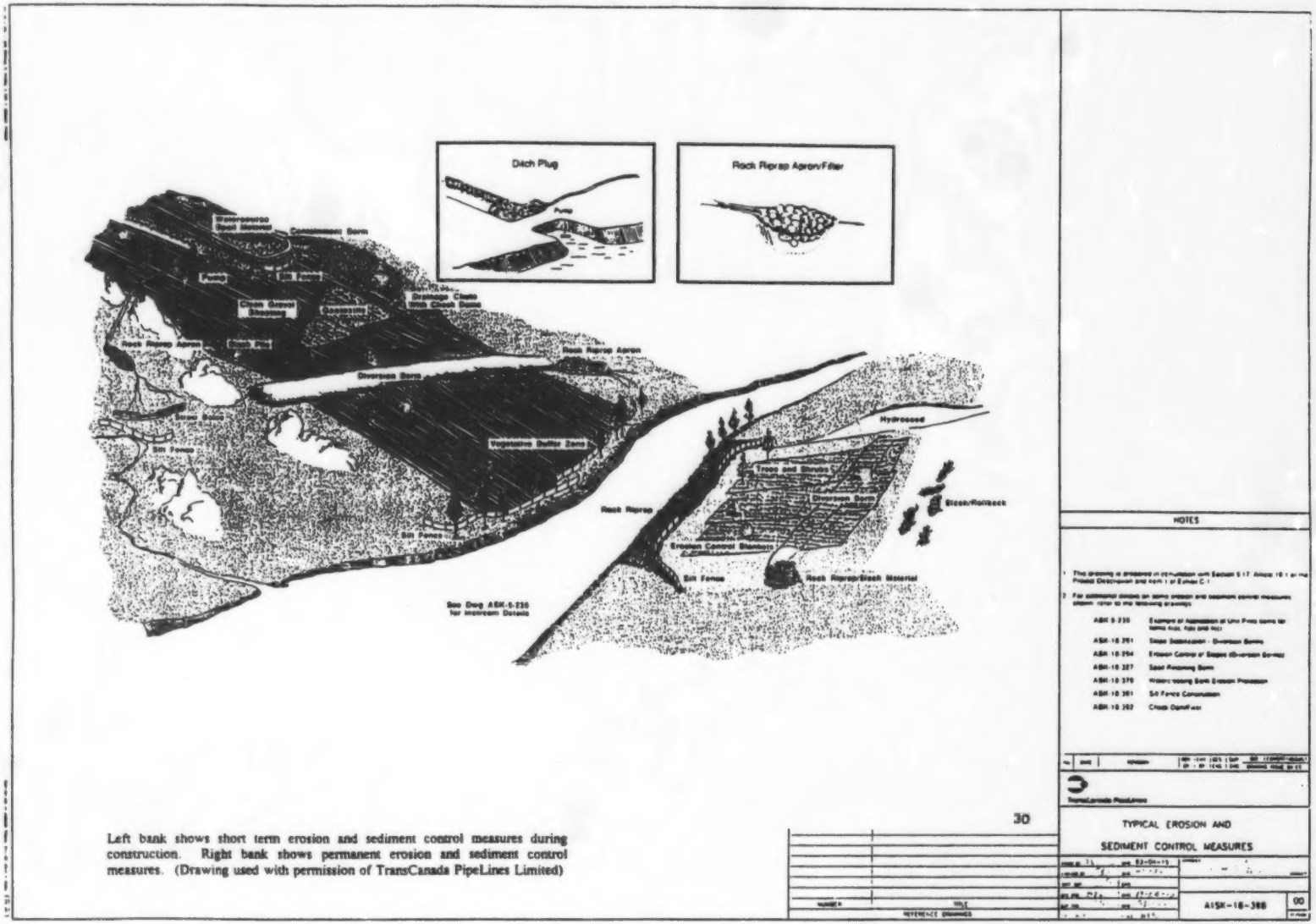
3 Sediment Control Plans: Reducing Sediment Concerns at Water Crossings, B. Adamson and A. Harris, Technical Note TN-20, OMNR Northwest Region, 1992.

4 In-stream Sediment Control Techniques - Field Implementation Manual, Trow Consulting Engineers Ltd., OMNR Northeast Region, 1996.


Earth cuts sloped to a stable angle of repose will encourage natural erosion control with vegetation.
Check dams across roadside ditches will slow down water velocities and prevent erosion on steep grades.
Rip rap at the ditch bottom and on the fill slopes at culverts will prevent erosion problems.
A diversion berm is used to divert flow into a cross-culvert or off the right of way into the bush.
Sediment traps are dug to collect sediment and prevent its movement further downstream.
The most economical erosion control method is to retain existing vegetation and organic material
The most economical sediment control method is to use the forest floor litter as a litter to trap sediment.
Slash debris pushed into the soil controls erosion and sediment by reducing flow velocities.
Revegetation is encouraged with stable slopes, retaining organic material and seeding.
Silt fences are a short term measure to trap sediment during construction until vegetation is established.
Rock or boulder rip rap prevents bank erosion and scour under abutments or piers.
Protection or enhancement of fish spawning beds requires particular attention when crossing a rapids.

Mitigation techniques are used for controlling erosion and sediment to protect water quality and fish habitat.

Figure 4. Diagram of typical erosion and sediment control measures used on access road water crossings (From OMNR Environmental Guidelines for Access Roads and Water Crossings).



Left bank shows short term erosion and sediment control measures during construction. Right bank shows permanent erosion and sediment control measures. (Drawing used with permission of TransCanada PipeLines Limited)

Figure 5. Diagram of typical erosion and sediment control measures used on pipeline water crossings (Used with permission of TransCanada Pipelines).

F.5 FISH SCREENING TECHNIQUES

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Fish protection at water intakes is a challenging task from both a biological and an engineering perspective. Fish may be injured or lost by falling over spillways or being drawn into turbines, irrigation canals, cooling towers, pumping stations, industrial and municipal water supply lines. Techniques to prevent entrainment or impingement of fish include physical exclusion devices, guidance systems, behavioral methods, and ways of bypassing fish around barriers. Physical exclusion devices are the most common and most widely accepted techniques offering the highest level of protection for fish and include a variety of fixed or travelling screens. Fish guidance systems include perceptual devices such as louvers, surface collectors and bypass chutes and normally offer a lower fish protection level at a lower cost. Behavioral methods, such as strobe lights, acoustic arrays, or electrical fields are not reliable and usually do not provide an acceptable level of fish protection. Bypass systems include barging, trapping and trucking, fish pumping, flow spilling at critical migration times, and may be suitable in some cases. Most fish protection techniques have been tested with juvenile salmonids, and testing to meet the needs of other species is needed. The effectiveness of physical exclusion and fish guidance systems is based on the design and hydraulic characteristics of the device, fish swimming capabilities, and fish responses to such systems. A special facility, the Ichthyo-Hydraulics or I-H Flume, designed, constructed, and used in 1997, enables the study and testing of such devices with fish in near prototype conditions. A combination of such studies and field monitoring of fish screening techniques is needed for the development of design criteria and guidelines.